US Robotics®

COURIER™ HIGH SPEED MODEMS

COURIER HST Dual Standard *terbo* FAX™ with ASL™

COURIER V.32 *terbo* FAX™ with ASL™

USER'S MANUAL

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8100 North McCormick Blvd.
Skokie, IL 60076

HOW TO USE THIS MANUAL

This manual contains operating instructions for Courier V.32 *terbo*, and Courier HST Dual Standard modems. These modems have identical features except for the signaling they use to connect with remote modems at high speeds: V.32/V.32 *terbo* or HST. Courier HST Dual Standard modems use either type of signaling, depending on the type of remote modem.

If you've purchased a Courier V.32 *terbo* modem, disregard the instructions in this manual concerning HST operations.

Below is a brief description of the manual's contents.

- Chapter 1—Operating and compatibility features
- Chapter 2—Installation and testing
- Chapter 3—Data mode commands
- Chapter 4—Fax mode and Call Selection
- Chapter 5—Queries and Help commands to display current settings, operational summaries, and other data

The Appendixes in Part II cover the following subjects.

- Background information on error control, throughput and flow control
- Summaries and tables
- Dial Security operations
- Troubleshooting
- Online synchronous and V.25 *bis* synchronous operations
- Additional features such as HST Cellular and voice/data switch
- Procedures for modem testing
- Glossary
- Warranty/Service/Certification information

A NOTE ON COMMUNICATIONS SOFTWARE

If you're using a computer rather than a terminal, you need communications software. Many brands are available, all of which are based on the modem's AT command set.

Some users prefer their communications software to take control of the modem, and are more comfortable with a program that makes the modem almost transparent. Others prefer a program that allows them to use the modem's AT command set sometimes, and their software at other times, depending on the task at hand. Review at least Chapter 3 so that you have a basic understanding of the modem's requirements and operation.

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LIMITED WARRANTY

U.S. Robotics, Inc., warrants to the original consumer or other end user purchaser that this product is free from defects in materials or workmanship for a period of two years from the date of purchase. During the warranty period, and upon proof of purchase, the product will be repaired or replaced (with the same or similar model) at our option, without charge for either parts or labor. This warranty shall not apply if the product is modified, tampered with, misused, or subjected to abnormal working conditions.

REPAIR OR REPLACEMENT AS PROVIDED UNDER THIS WARRANTY IS THE EXCLUSIVE REMEDY OF THE PURCHASER. THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR USE OR PURPOSE, AND U.S. ROBOTICS SHALL IN NO EVENT BE LIABLE TO PURCHASER FOR INDIRECT OR CONSEQUENTIAL DAMAGES OF ANY KIND OR CHARACTER.

Some states do not allow the exclusion or limitation of incidental or consequential damages or allow limitations on how long an implied warranty lasts, so the above limitations or exclusion may not apply to you. This warranty gives you specific legal rights. You may also have other rights which vary from state to state.

To obtain service under this warranty, contact the U.S. Robotics Technical Support Department by fax, (708) 982-5235, by phone, (800) 982-5151, or by mail, 8100 North McCormick Blvd., Skokie, Illinois, 60076-2999. You will be given a Return Materials Authorization (RMA) number to help us keep track of your warranty request. Once you have received your RMA number, take or mail the product, postage prepaid, to U.S. Robotics at the above address. Include proof of the date of purchase. IMPORTANT: If you ship your unit, pack it securely, be sure your RMA number is visible on the outside of the package, and ship it charges prepaid and insured. Modems without an RMA will not be accepted.

Should you encounter problems in operating this device, follow the instructions in Appendix D in Part II of this manual. The

appendix contains solutions to operating problems as well as procedures to follow if there is an apparent modem malfunction.

FCC REGISTRATION

FCC68: CJEUSA-73130-FA-E

RINGER EQUIVALENCE: 0.4B

FCC15: CJE-0151-234

DOC (CANADA)

This digital apparatus does not exceed the Class B limits for radio noise emissions from digital apparatus set out in the radio interference regulations of the Canadian Department of Communications.

Le present appareil numerique n'emet pas de bruits radio-electriques depassant les limites applicables aux appareils numeriques de la classe B prescrites dans le Reglement sur le brouillage radioelectrique edicte par le ministere des Communications du Canada.

CONNECTING TO THE TELEPHONE COMPANY

It is not necessary to notify the telephone company before installing the modem. However, the telephone company may request the telephone number(s) to which the Courier is connected and the FCC information printed above.

If the telephone company has any questions or raises problems, ask them to call the Technical Support Department, U.S. Robotics, Inc., (800) 982-5151.

If the modem is malfunctioning, it may affect the telephone lines. In this case, disconnect the modem until the source of the difficulty is traced. Do not use the modem on party or coin telephone lines.

RADIO AND TELEVISION INTERFERENCE

This equipment generates and uses radio frequency energy and if not installed and used properly, in strict accordance with the manufacturer's instructions, may cause interference to radio and television reception. Courier high speed modems have been tested and found to comply with the limits for a Class B computing device in accordance with the specifications in Part 15 of FCC rules, which are designed to provide reasonable protection against such interference in a residential installation.

However, there is no guarantee that interference will not occur in a particular installation. If this device does cause interference to radio or television reception, which you can determine by monitoring reception when the modem is on and off, try to correct the problem with one or more of the following measures.

- Reorient the receiving antenna.
- Relocate the computer with respect to the receiver.
- Relocate the computer and/or the receiver so that they are on separate branch circuits.

If necessary, consult your dealer or an experienced radio/television technician for additional suggestions. You may find the following booklet, prepared by the Federal Communications Commission, helpful:

How to Identify and Resolve Radio-TV Interference Problems
Stock No. 004-000-0345-4
U.S. Government Printing Office
Washington, DC 20402

In accordance with Part 15 of the FCC rules, any modification to or tampering with this device that causes harmful interference to others may be reason for prohibiting future operation.

FOR CANADIAN MODEM USERS

The Canadian Department of Communications (DOC) label identifies certified equipment. This certification means that the equipment meets certain telecommunications network protective, operational, and safety requirements. The department does not guarantee the equipment will operate to a user's satisfaction.

Before installing this equipment, make sure you are permitted to connect it to the facilities of the local telecommunications company. You must also install the equipment using an acceptable method of connection. In some cases, you may also extend the company's inside wiring for single line individual service by means of a certified connector assembly (telephone extension cord). You should be aware, however, that compliance with the above conditions may not prevent degradation of service in some situations.

Repairs to certified equipment should be made by an authorized Canadian maintenance facility designated by the supplier. Any repairs or alterations made by a user to this equipment, or equipment malfunctions, may give the telecommunications company cause to request the user to disconnect the equipment.

For your own protection, make sure that the electrical ground connections of the power utility, telephone lines, and internal metallic water pipe system, if present, are connected together. This precaution may be particularly important in rural areas.

CAUTION: Do not attempt to make such connections yourself; contact the appropriate electric inspection authority or electrician.

Courier High Speed Modems Load Number: 5

The Load Number (LN) assigned to each terminal device denotes the percentage of the total load to be connected to the telephone loop used by the device, without overloading. The termination on a loop may consist of any combination of devices, subject only to the requirement that the total of the Load Numbers of all the devices not exceed 100.

CHAPTER 1. FEATURES AND COMPATIBILITY

INTRODUCTION

Congratulations! The Courier modem you've purchased represents powerful, advanced electronic design that offers exceptional reliability, compatibility and flexibility at all standard rates up to 19,200 bps or 19.2K bits per second (bps). The transmission rate between the computer and modem, depending on your equipment and software support, can be as high as 115.2K bps.

The following features and capabilities assure you of superior reliability and performance.

Connections up to 21.6K bps

With our new implementation of V.32 *terbo*, two Courier modems with this feature can connect at rates up to 21.6K bps and fallback to rates of 19.2K bps and 16.8K bps. These rates represent a rate of up to over 30% greater than the rates of standard ITU-T (formerly CCITT) V.32 *bis* modems which are limited to calls of 14.4K bps or less.

Quick Train

Courier high speed modems can handshake and start transmitting in less than 2 seconds, in contrast to typical training times that range between 9 and 18 seconds.

High Speed Calls—Adaptive Speed Leveling (ASL)

Like most high speed modems, Courier modems fall back to the next lower speed, for example, 19.2K, then 16.8K, if poor line conditions warrant. In addition, Courier modems detect improved line conditions and shift upward again to the next higher speed. ASL keeps the modems online, always operating at the highest possible speed, and constantly ensuring data integrity.

Fax Capability—Courier Fax Modems

You can use your modem in Class 1, Class 2.0, and Group III facsimile mode for sending or receiving faxes.

Error Control—V.42/MNP

Data integrity is ensured when the modems connect with remote modems that use the V.42 (LAPM), USR-HST, or MNP error control protocols. Error control is available on calls at 1200 bps and above.

Data Compression—V.42 bis/MNP5

Data compression enables potential throughput of well over 60K bps on 19.2K or 21.6K bps connections. Couriers connecting under V.42 or HST error control use V.42 *bis* compression. Couriers connecting under MNP error control use MNP Level 5 compression. Achievable throughput of text and other types of files is listed in Appendix A.

Flow Control/Variable Interface Rates

Flow control, required under error control, also allows the local computer interface rate to be set higher than the link rate, enabling greater efficiency and throughput. If your equipment and software support high rates, data can be sent from the computer to the modem at 115.2K, 57.6K, 38.4K or 19.2K bps, regardless of the link rate.

Voice/Data Switch

A switch on the modem's front panel allows you to change from voice to data and back again, without issuing a command.

Stored Command String

If you don't ordinarily use voice and data in the same call, you can assign the voice/data switch a different function that normally requires a command, such as resetting the modem or executing a stored command string. See *Voice/Data* in Appendix F for instructions on use of the voice/data switch.

Asynchronous/Synchronous Capability

Courier high speed modems operate synchronously as well as asynchronously. A personal computer equipped with a synchronous interface adapter can call computers that use standard synchronous protocols. See Appendix E for more information.

Synchronous Operations with V.25 bis

Used with computers that have a synchronous card and port, Courier high speed modems combine the power of older

modems and automatic calling units in the mainframe environment. They make synchronous connections by utilizing V.25 *bis*, character-oriented (similar to BISYNC) and HDLC protocols. See Appendix E for more information.

Dial Security

With Dial Security, you will be able to prevent unauthorized access to a system with the use of Autopass, Prompting, and Dialback. See Appendix C for more information.

Programmable Nonvolatile Memory

You can tailor your own default settings and store them in non-volatile random access memory (NVRAM). Each time the Courier is powered on or reset, it operates at the settings you've specified.

Link Rate Negotiation

The Courier automatically lowers its link rate to match a lower rate of a remote modem, in both Originate and Answer Modes, allowing connections with a wide range of installed modems.

Link Diagnostics

After each call, you can display a Link Diagnostics screen containing information about the last call, including the number of data characters transferred, line statistics, the call's rate and the reason the call was disconnected.

Modem Diagnostics

ITU-T V.54 loopback testing with the &T command options, and earlier Courier Register S16 test options are available. The modem performs three loopback tests: analog, digital, and remote digital. See Appendix G for information.

Inactivity Timer

You can set the modem to automatically hang up after a specified number of minutes if there is no activity on the phone line.

Call Duration Reporting

The modem records the duration of your calls in hours, minutes, and seconds. This feature enables you to display and print an audit of your calling activities. You can optionally use the modem clock as a real-time clock.

Call Progress Detection

An optional set of result codes (screen messages) lets you know when a line is busy, a person rather than a modem has answered the phone, there is no dial tone, or the distant phone is ringing.

Modem Settings Displays

On command, the modem displays its current settings, a handy way to check your transmission rate, S-Registers and other operational controls. The modem also displays the defaults stored in nonvolatile memory as well as its default configuration templates.

HELP Screens

The modem displays screens that summarize the command sets, Dial command options, and S-register functions.

Bottom Panel Reference

Command summaries and other information are printed on the bottom of the modem case. A Dual In-Line Package (DIP) switch guide makes it easy to tailor the switch settings to your terminal or software requirements.

Dialing the Last-Dialed Number

The modem has a buffer that stores each dialed number until it is cleared by another Dial command. A few keystrokes cause the modem to redial the number in the buffer without your having to enter the number again.

Automated Redialing

You can put the modem into Repeat Mode to continuously redial if a previous dial attempt fails to connect. This is especially useful in dialing services whose lines are often busy.

Quote Mode

Set the modem to Quote Mode if you want it to dial an alphabetic acronym instead of a numeric number.

COMPATIBILITY

The Courier adheres to the following standards, ensuring compatibility with a wide base of installed modems. Unless otherwise indicated, V.32 *terbo* and Dual Standard modems both conform to the listed standards.

NOTE: The International Telecommunication Union (ITU-T) was formerly the International Telegraph and Telephone Consultative Committee (CCITT).

USR-V.32 *terbo*	21.6K/19.2K/16.8K/14.4K/12K/9600/7200/4800 bps (Dual Standard and V.32 *terbo* modems)
USR-HST	16.8K/14.4K/12K/9600/7200/4800 bps (Dual Standard modems in HST mode)
USR-HST Cellular	Cellular connections at 12K/9600/7200/4800/2400/1200/300 bps (Dual Standard modems in HST mode)
ITU-T V.32 *bis*	14.4K/12K/9600/7200/4800 bps
ITU-T V.32	9600/4800 bps
ITU-T V.22 *bis*	2400 bps
Bell 212A	1200 bps (also V.22)
ITU-T V.23	1200 bps with 75 bps back channel (optional, some United Kingdom and European phone systems)
ITU-T V.25	Answer sequence for calls originating outside the U.S. and Canada
ITU-T V.25 *bis*	For synchronous communications using HDLC and character-oriented protocols
Bell 103	300 bps (ITU-T V.21 optional)
ITU-T V.42	LAPM error control, 1200 bps and higher
ITU-T V.42 *bis*	Data compression, 1200 bps and higher
MNP	Levels 2, 3 and 4 error control, level 5 data compression, 1200 bps and higher
ITU-T V.54	Analog, digital and remote digital loopback testing

Fax Standards

The Courier modem provides Group III-compatibility when combined with Class 1 or Class 2.0 fax software. In addition, the modem adheres to the following standards.

TIA/EIA-578	Service Class 1 Asynchronous Facsimile DCE Control Standard
TIA/EIA-592	Service Class 2.0 Asynchronous Facsimile DCE Control Standard
ITU-T V.17	14.4K/12K bps
ITU-T V.29	9600/7200 bps
ITU-T V.27 *ter*	4800/2400 bps
ITU-T V.21	300 bps

Other compatibility features include the following standards and certification:

- Can be used with any computer or terminal that is compatible with the RS-232 standard interface.
- Can be used with any computer or terminal that uses ASCII, the standard character code supported by most equipment manufacturers.
- Is fully FCC- and DOC-certified for the uses described in this manual.

CHAPTER 2. SET-UP AND TESTING

Figure 2.1—Courier High Speed Modems

PACKAGE COMPONENTS

Your Courier modem package contains the following items:

- The modem you purchased: Courier HST Dual Standard, or Courier V.32 *terbo*.
- A *STOP* guide with listings of Courier DIP switch and other settings recommended for a number of popular communications software products, plus tips for a quick startup.
- An RJ-11-C phone cord.
- A power adapter.
- WinFax LITE fax software and manual.
- A Quick-Reference card
- Your warranty card, to be filled out and returned to U.S. Robotics, Inc.

OPERATIONAL REQUIREMENTS

The Courier modem has minimal operational requirements. Be sure to read the information in the front of this manual about

radio and television interference and connecting to the phone company. In addition, you should be aware of the following conditions.

- Follow the operating instructions in Appendix E, *Synchronous and Leased Line Operations*, if your phone line is user-installed or if it is leased from the telephone company. Also referred to as *private*, these lines are used for a direct, continuous connection between two modems. The connection is made without dialing.
- If your modem is installed in a Hewlett Packard system that uses the *Ack/Enq* communications protocol, be sure to follow the instructions in Appendix F.
- If the modem is attached to a computer instead of a terminal, you need communications software. The software uses the modem's AT command set to control many communications functions, including configuring the modem, dialing, and answering calls, and also enables the transfer of files and other operations.

  Some users prefer their communications software to take control of the modem, and are more comfortable with a program that makes the modem almost transparent. Others prefer a program that allows them to use the modem's AT command set sometimes, and their software at other times, depending on the task at hand. Whichever you prefer, review Chapter 3 so that you have a basic understanding of the modem's requirements and operation.

RS-232 Requirements

You'll need an RS-232 cable to connect the modem to your computer or terminal. *Use a shielded cable* to ensure minimal interference with radio and television reception.

The modem takes a DB-25P (25-pin plug, or male) connector at one end of the cable. Computer equipment varies, however. Check the serial port at the rear of your machine, which may be labeled SERIAL, COMM PORT, or some other term (e.g., RS-232). If there are no labels, review your machine documentation to find out which is the serial port. (There may be more than one.) Don't use a port marked PARALLEL, PRINTER or AUX.

The physical serial port on the computer or terminal will be either a socket (female) or plug (male) that typically accommodates 25 or 9 pins. For example, the port on the IBM PC, PC/XT and most compatibles requires a DB-25S (socket) connector, while the port on the IBM PC/AT and some compatibles requires a DB-9S connector. Apple computers require a DB-25P, DB-9P or, more typically, an 8-pin round plug connector. Check your computer documentation or with your computer dealer.

NOTE: Appendix B includes a listing of RS-232 pin assignments required to operate the modem. Be sure to check the appendix if you're not sure what type of cable you need, or if you're building your own. If your machine has other than a 25- or 9-pin port, check your computer documentation or consult your dealer to find out what type of RS-232 connector is required.

WARNING: If you're planning to use the high speed computer-to-modem rates of 115.K, 57.6K or 38.4K bps, follow the instructions concerning the RS-232 cable in Appendix B. The guidelines there will help you to avoid signal degradation at very high speeds.

SWITCHES

Voice/Data

This pushbutton switch is used primarily to switch between voice and data communications during a call. Detailed instructions are in the *Voice/Data Calls* section in Appendix F. The switch has multiple functions, however. Options are as follows:

- Disable the switch
- Force the modem off hook in Originate mode
- Force the modem off hook in Answer mode
- Have the modem redial the last dialed number
- Have the modem dial the first number you've stored in nonvolatile memory
- Toggle Auto Answer on and off
- Reset the modem to its defaults
- Initiate Remote Digital Loopback testing
- Busy out the phone line
- Execute stored command string (default)

Volume Control

This is a slide switch underneath the right side panel of the modem, near the front corner. Sliding it toward the front of the modem increases the volume of the modem's speaker; sliding it toward the rear of the modem decreases the volume.

FRONT PANEL INDICATORS

Below is a list of the modem's twelve status lights, or LEDs. See Appendix B for descriptions of their operations.

HS	High Speed
AA	Auto Answer
CD	Carrier Detect
OH	Off Hook
RD	Received Data
SD	Send Data
TR	Data Terminal Ready
MR	Modem Ready (Power)
RS	Request to Send
CS	Clear to Send
SYN	Synchronous
ARQ/FAX	Automatic Repeat Request (Error Control)/ Fax mode

INSTALLING THE MODEM

1. Turn off the computer or terminal and its peripheral devices.
2. Examine the label on the bottom of the modem. In addition to the summaries and other information, the label contains icons to aid in modem assembly. Check the interfaces at the back of the modem, shown in the following photograph.

Figure 2.2—Interface End, Courier Modem

3. Now review the attached interfaces in Figure 2.3.

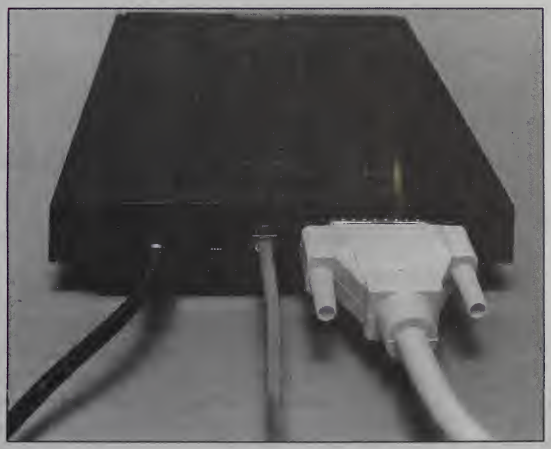

Figure 2.3—Connected Courier Modem

4. Check to make sure that the power switch is OFF; press it towards the zero in the 0/1 icon on the bottom label. Plug the power supply adapter's small connector into the power jack at the back of the modem. Plug the adapter into a standard 115-volt AC wall socket.

Disconnect your present phone cable from the wall jack. Plug one end of the phone cable that came with the modem into the modem's phone jack that is near the wall-jack icon on the bottom label. Plug the other end into the wall jack.

NOTE: Older telephone installations may not have the appropriate modular wall jack and plug. Adapters and RJ-11-C connectors are available from your telephone company or computer dealer.

If you want to keep your telephone connected for conventional calls, plug its cord into the jack at the rear of the modem near the phone icon. You can also use both your telephone and modem in one call, although not at the same time. *Voice/Data*, in Appendix F, explains how to switch control of the phone line between the phone and the modem.

5. Next, check the positions of the bank of Dual In-Line Package (DIP) Switches located in the well at the bottom of the modem. These switches are set at the factory to the positions most users require.

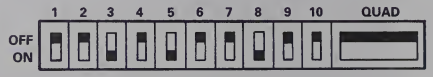

Figure 2.4—DIP Switch Factory Settings

The *STOP* guide that came with the manual shows recommended switch settings for many widely-used communications software products. If your communications software is not listed, check your software documentation for its requirements, particularly for DIP switches 1, 4, 5 and 6. You'll also find descriptions of switch functions and options in Appendix B.

If you already know your requirements, use the guide on the bottom of the modem or the summary in the Quick Reference Card to verify the switch positions.

NOTE: If you have built your own RS-232 cable and it does not support Data Terminal Ready (DTR), set DIP switch 1 ON, for the DTR override. The override causes the modem

to operate as if the DTR signal is always ON, and enables the modem to accept commands. Most purchased communications software, however, requires DTR.

DIP switch 10 is explained under *Setting/Using Defaults* in Chapter 3. Most users will want to leave this switch OFF, write their own defaults to nonvolatile memory (NVRAM), and have those defaults loaded at power on.

The wider *Quad* switch on the right of the numbered switches should be left OFF *unless you know your equipment reverses the transmit and receive pins at the RS-232 interface* (see Appendix B, *DIP Switch Summary*).

6. The final step is to connect the modem to the computer's or terminal's serial port with the RS-232 cable described earlier in this chapter. Attach the appropriate connectors to the modem and to the serial port.

NOTE: To prevent overheating, do not cover the vents on the top of the modem case.

TESTING THE INSTALLATION

Use the following procedures to verify that your modem is working properly.

1. Turn on your computer or terminal and clear the screen. Then turn the Courier's power switch ON. The following front panel indicators, or LEDs, will light up.

   CD Carrier Detect, if you have set DIP switch 6 ON, enabling the CD override

   TR Data Terminal Ready, if you have set DIP switch 1 ON, enabling the DTR override

   MR Modem Ready/Power ON

   CS Clear to Send

   For more information on the front panel indicators, see Appendix B in the.

2. If you're using a personal computer, load your software to start the program. Set your terminal or software to 19.2K bps or 9600 bps. In addition, set a word length of either 7 bits plus 1 parity bit, or 8 bits with no parity—it doesn't matter which now—and 1 Stop bit.

3. If your software allows, perform the function that lets you send AT commands to the modem, that is, puts the computer in *Terminal mode*. Some communications programs do this automatically upon loading. Others require you to display a communications or terminal screen, type a Function key, or perform some other operation.

   If necessary, review your communications software documentation for instructions.

4. Check to see if your computer or terminal and modem are communicating with each other by sending the following *attention* command. Type either upper or lower case letters, not a combination, and then press the Enter (Carriage Return) key, shown in the example below between angle brackets. (Don't type the angle brackets.)

   AT <Enter>

   If everything is correct, the modem responds as follows:

   OK

   NOTE: The modem is shipped with DIP switch 4 OFF, causing the modem to display (echo) your keyboard commands. If your entered command is not displayed, your local echo is OFF. To turn the local echo ON, send the modem the following command.

   ATE1 <Enter>

   If double characters appear on the screen, both your modem and software are set to local echo ON. Either set your software to local echo OFF, or turn the modem's echo OFF with the following command.

   ATE0 <Enter>

Troubleshooting

If no OK appears on your screen, review the following checkpoints.

a. Make sure you type all upper or lower case letters and press <Enter>.

b. Check to see that you set your communications software to the correct serial port.

c. Make sure your software has put the computer in Terminal mode, so that you can send the modem commands. Then review Step 4, above.

d. Be sure that DIP switches 1 and 6 are set ON or OFF according to your terminal or software requirements. The table in Appendix B explains each function, and you may also need to review the quick-configuration guide or your terminal or communications software documentation .

e. The Quad switch on the right should be in the OFF position.

f. If you set DIP switch 8 OFF, for Dumb mode, reset the modem to Smart mode: set DIP switch 8 ON, power off the modem, and power it on again.

g. DIP switch 3 controls the display of the modem's result codes, including the OK result. The modem is shipped with DIP switch 3 ON, enabling the result codes. If DIP switch 3 is OFF, reset it to the ON position. Then initiate the new switch setting with the following reset command.

ATZ <Enter>

5. A final check of the modem is to see that it gets a dial tone. Type the following manual Dial command:

ATD <Enter>

On receipt of the command, the modem goes off hook and waits for a dial tone. The OH indicator lights, and you'll hear the dial tone from the modem's speaker. To cancel the operation, press any key.

If you don't hear the dial tone, first increase the volume by sliding the volume control switch towards the front of the modem. If that doesn't work, check to see that the phone cable from the wall jack is connected to the jack that has a wall jack, and not the phone, icon. If necessary, reconnect the phone cable correctly. Then try the manual Dial command again, ATD <Enter>.

CHAPTER 3. DATA MODE OPERATIONS

The information in this chapter applies to asynchronous calls only. For synchronous operations, refer to Appendix E.

Detailed command descriptions are in this chapter. Additional command summaries are on the bottom panel of the modem and in the Quick-Reference Card.

COMMAND SET USAGE

The Courier command set enables you to send the modem two kinds of instructions:

- operations, such as dialing or hanging up
- configurations, such as enabling error control or data compression

Follow these guidelines:

1. Your software must be loaded and your computer or terminal must be in Terminal mode.

   In Terminal mode the computer acts as if it were a standard terminal such as a teletypewriter, rather than a data processor. Keyboard entries go directly to the modem, whether the entry is a modem command or data to be transmitted over the phone lines. Received data is output directly to the screen. The more popular communications software products place the computer in terminal mode when the software is loaded.
2. Type commands in either upper or lower case, not a combination.
3. All commands except A/, A> and +++ are preceded by the AT prefix and are executed with the Enter/Carriage Return key (<Enter>).
4. Command length = 40 characters maximum. The modem doesn't count the AT prefix, Carriage Return character, or spaces. It counts but doesn't act on punctuation such as hyphens and parentheses.

5. A missing numeric parameter is assumed to be zero, as in the command to hang up: ATH <Enter> is the equivalent of ATH0 <Enter>.

Example (spaces are not required, but are added here for readability):

AT &K3 X2 DT 071 312 1234 <Enter>

Meaning:

AT	Get ready to execute the following commands.
&K3	Disable MNP5 data compression, use only V.42 *bis* compression.
X2	Use the X2 result code subset.
DT	Dial the following phone number using tone dialing.
<Enter>	Execute the commands.

This chapter groups related commands into the following categories.

- Basic Commands
- Dialing/Answering
  - Dialing
  - Dial Options
  - Store Phone Numbers
  - Redialing
  - Answer Mode
  - Auto Answer
  - Hanging Up
- Setting/Using Defaults
  - Resetting the Modem
- Configuration:
  - Echo/Speaker
  - Result Codes
  - Modulation
  - Error Control/Data Compression
  - Data Rates
  - RS-232 Signal Operations
  - Flow Control
- S-Registers
- Inquiry and Help
- Testing
- International Calls
- Miscellaneous Commands

For an alphabetical listing of commands, check the first page of the index.

NOTE: The defaults listed are based on the modem's shipping configuration: load from nonvolatile random access memory (NVRAM), DIP switch 10 OFF, which is the same as the &F1 configuration template). For a complete listing of default configuration templates, see Appendix B.

BASIC COMMANDS

AT — Attention command prefix. Use AT alone to test for the OK result code. AT must prefix all commands except A/, A> and +++.

Any key — Terminate the current dialing operation resulting from an issued Dial command; terminate Repeat mode (> or A>).

DIALING/ANSWERING

Dialing

D*n* — Dial the specified phone number; also execute Dial options.

The maximum number of characters allowed is 36, including the AT prefix, punctuation and spaces. The Carriage Return (Enter key) isn't counted as a character.

NOTE: With the exception of the following Dial options, the modem ignores any commands issued after D in the same command string.

Dial Options

D — Dial the number that follows and enter Originate mode. Optional parameters:

- P — Pulse dial (Default).
- T — Tone dial.
- , — (Comma) Pause for 2 seconds before continuing to dial.
- ; — Return to Command mode after dialing. If your phone is plugged into the modem, you can use this option to have the modem Auto Dial a telephone rather than a modem. The Courier dials, remains off hook and returns the OK message, indicating it is in Command mode.

For example, to have the modem place a voice call, enter the Dial command with a semicolon:

ATDT5551234; <Enter>

When the modem returns the OK result, pick up your phone receiver so you can talk to the other party, and send the command that hangs up the modem:

ATH <Enter>

" Dial the letters that follow (in an alphabetical phone number). **NOTE:** If you are including another command after the dial string, use closing quotation marks before the additional command.

! Transfer a call (flash the switch-hook). This command applies to modems in installations where other modems share the phone line. The modem flashes the switch-hook (goes off hook 0.5 seconds, on hook for 0.5 seconds and off hook again) to dial the specified extension.

W This command is useful in situations where you must wait for a second dial tone before continuing dialing. For example, if you need to dial for an outside line, the Courier continues dialing as soon as it detects the next dial tone.

AT DT 9 W 5551234 <Enter>

NOTE: This command executes only if result code option X3 or greater has been issued. If the modem is set to X2 or lower, the modem interprets the W as a comma (two-second pause).

@ Wait for an answer (with X3 or higher). Some online services answer the phone and return a tape-recorded request for information before processing transactions. In such instances, the @ command can be used in the Dial string to tell the modem to detect at least one ring, wait for five seconds of silence at the other end of the call, and then continue to execute the Dial string.

To use the @ command, set the modem to X3, X4 or X7. If the modem is set to X2 or lower, the modem returns an ERROR message when encountering the @ character in a command string. If set to X5 or X6, the modem hangs up

when it detects a voice answer and sends the VOICE result code.

/ A slash (/) causes to pause for only 125 milliseconds.

R Reverse frequencies. This command allows calls to an originate-only modem. It reverses the modem's originate/answer frequencies, forcing the Courier to dial out at the answer frequency. The command follows the Dial command, before or after the phone number:

AT D1234567R <Enter>

X2-X7 Adaptive dialing. When any of the X2 through X7 options is in effect and you do not issue a dialing type in the Dial string, the Courier uses tone dialing, which is faster than the default pulse type. However, if the phone company's central office does not have tone detection equipment, the modem cannot break dial and continues to detect the dial tone. If this occurs, the modem automatically reverts to pulse dialing.

DL Dial the last-dialed number. The modem stores each Dial command until it receives the next Dial command. Use DL instead of A/, described on the next page, if you wish to send the modem non-Dial commands before dialing again.

DS*n* Dial the number stored in nonvolatile random access memory at position *n*, where *n* = 0–9.

Store Phone Numbers

&Z*n*=*s* This command stores up to ten numbers, where *n* is the position 0–9 in nonvolatile memory, and *s* is the phone number string. The number-string may be up to 36 characters long, including any Dial command options.

AT &Z2=555-6789 <Enter>

Do not include modem settings in the &Z*n* string. If the call requires a special setting, insert it in the command string before the DS*n* command. In the following example, &M0 (no error control) is inserted before the Dial command:

AT&M0 DS2 <Enter>

NOTE: The &Z*n*=*s* command functions differently when Dial Security is enabled. See Appendix C for more information.

&Z*n*? Display the phone number stored in NVRAM at position *n* (*n* = 0–9).

Cancel Dialing

To cancel Dial-command execution, press <any key>. If you inadvertently hit a key on the keyboard while the modem is dialing, the call is canceled. If this occurs, type the A/ command explained under *Automated Redialing* below.

When the modem receives a command, it stores the instruction in its command buffer until it receives the next AT command. Note that if you've sent the modem an additional command since the Dial command, A/ re-executes that command instead of redialing.

Redialing

A/ Re-execute the last issued command. A/ doesn't take the AT prefix or a Carriage Return, and can be used to redial.

A/

Automated Redialing (>, A>)

While > and A> can be used to continuously repeat any command, they are designed for automated redialing.

Enter Repeat Mode

> If you know the modem you are calling is frequently busy, include the Repeat command in the Dial string, as follows:

AT > DT 1234567 <Enter> or
AT DT 1234567 > <Enter>

The modem enters Repeat mode, dials the number, waits 60 seconds for a carrier (default), and hangs up. Then after a two-second pause, it redials.

The cycle continues until the modems connect or the modem reaches a maximum of 10 attempts. The 10-try limit is mandated by the Canadian Department of Communications (DOC) to prevent tying up local telephone company exchanges with unconnected calls.

A> This command combines the features of both the A/ and > commands. The modem enters Repeat mode as described above, and redials the Dial string in the command buffer. Like

the A/ command, A> does not take the AT prefix or a Carriage Return.

Exiting Repeat Mode

Should you use > or A> with a command other than a Dial string, abort the cycle by pressing <any key>.

To abort automated redialing, be sure to press <any key> when the result code appears, during the pause before the modem begins dialing again. If you press <any key> while the modem is dialing, that dial attempt is canceled but the cycle continues.

Answer Mode

Force Answer Mode

A Force Answer mode when the modem hasn't received an incoming call.

Auto Answer

The Courier is shipped with DIP switch 5 ON, Auto Answer suppressed. To set the modem to automatically answer incoming calls, do *one* of the following:

1. Before powering on the modem, set DIP switch 5 OFF. When you turn the computer on, the modem answers incoming calls on the first ring.

2. When the modem is on, set your communications software to enable auto answer. The following command instructs the modem to answer on the first ring. (You can substitute a higher value. See the S-Register summary in Appendix B.)

   AT S0 = 1 <Enter>

When the modem senses a call coming in, it sends the result code RING to your screen, goes off hook, and sends the remote modem a high-pitched answer tone. If there is no Carrier Detect within 60 seconds, the modem hangs up. If the connection is made, the modem sends a CONNECT result code. When the call is disconnected by you or the remote user, the modem hangs up and returns the NO CARRIER code.

NOTE: If DIP switch 5 is OFF and S0=0, the Auto Answer will be disabled. Be sure that S0=1–256.

Suppressing Auto Answer

To disable Auto Answer, reverse Steps 1 or 2 above. Set DIP switch 5 ON before powering on the modem, or set the modem to answer on zero rings with the following command.

AT S0 = 0 <Enter>

Points to Remember

1. If the modem is attached to a computer, you can set the modem to receive calls when you're not at your computer. Load your communications software as you normally do, and set the modem to Auto Answer. Also set your software's file-save function to save incoming messages and/or files.
2. If you've attached your phone so it can be used for conventional calls, disable Auto Answer when you are not expecting incoming data calls. Otherwise, your modem may answer the phone before you do, greeting a voice caller with a high-pitched, irritating answer tone.

Hanging Up

H*n* On/off hook control.

H0 Hang up (go on hook).

H1 Go off hook.

+++ Escape code operations. Once the modem is online to another system, the only command it recognizes is an *escape code* of three typed pluses, which forces the modem back to Command mode. Do the following when issuing the command:

- Wait one second after sending the last item of data
- Type: +++
- Wait one second before typing any data

Do not type the AT prefix or a Carriage Return. The guard time of one second before and after the code prevents the modem from misinterpreting the occurrence of +++ in the transmitted data stream.

If necessary, the character used in the escape code or the duration of the guard time can be changed by resetting Register S2 or S12. See the *S-Register Summary* in Appendix B.

In response to +++ the modem returns to Command mode. However, it keeps the line open or hangs up, depending on the setting of DIP switch 9:

DIP Switch 9	Response to +++
OFF	Modem goes on hook (hangs up), sends NO CARRIER result code (factory setting)
ON	Modem maintains connection (Online-Command mode), sends OK result code

The factory setting (OFF) forces an automatic disconnect when you issue +++. An advantage of this is that you are not likely to inadvertently run up an all-night phone bill.

Set DIP switch 9 ON if you want the modem to respond to +++ by entering Online-Command mode, enabling it to execute commands and return online. (See the O command, below.)

WARNING: *For unattended modem operations:* in rare instances, the modem may fail to recognize the +++ escape code sequence. If you are running the modem under software control for unattended operations, we suggest you use the surefire method of dropping the DTR signal from the computer or terminal for at least 50 milliseconds, to ensure against costly phone charges. Methods of turning the DTR signal off—for example, closing the communications port—differ from one computer to another.

Returning Online

On If DIP switch 9 is ON (on detection of the escape code the modem maintains the connection), you can issue commands and then toggle the modem back online with the O*n* command, as in this example:

AT Q1 O <Enter>

There are two ways to return online.

ATO0 Return online (normal). (Used in the example above.)

ATO1 Return online and retrain. Use to have the modem resynchronize if there were errors in a non-ARQ data transfer.

Hanging Up

If DIP switch 9 is ON, the escape code forces the modem back to Command mode but leaves the line open. If you want the modem to hang up, issue the following command once the modem sends the OK result code.

ATH <Enter>

If DIP switch 9 is OFF, the modem automatically hangs up on receipt of the escape code.

SETTING/USING DEFAULTS

The modem's read-only memory (ROM) permanently stores the modem's four factory template settings. The inclusion of nonvolatile random access memory (NVRAM) allows you to save one of these four templates, or add your own modifications, and write all the settings to NVRAM as your power-on defaults.

&F*n* The modem is shipped with four configurations (templates), &F0–&F3, stored in permanent nonprogrammable memory (ROM). Appendix B includes configuration listings for each template. Any one of the templates may be loaded into current memory (AT &F*n*) or written to nonvolatile memory and reset default (AT &F*n* &W). Note, however, that &F0 is always loaded into memory if DIP switch 10 is ON.

When you power on the Courier, it loads the settings stored in NVRAM if DIP switch 10 is OFF. Until you write your own settings to NVRAM, the defaults stored there are the same as the permanent ROM factory settings stored in position 1, &F1.

To view the &F1 settings, select option 5 of the I (inquiry) command:

AT I5 <Enter>

Customizing NVRAM

&W To substitute a template other than &F1, write the desired template to NVRAM, using the &W command.

AT &F2 &W <Enter>

To modify the &F*n* configuration in NVRAM, type your changes and then save them to NVRAM, as in the following example. The original factory template remains intact.

AT M2 S10=40 &A2 &W <Enter>

NOTE: When writing a different default configuration to NVRAM, insert your addition *after* the &F*n* command but *before* &W. Otherwise they will be overwritten by &F*n*.

After sending a configuration to NVRAM, you can change any setting just for the current session, as in the following example. The NVRAM configuration remains intact.

ATX6 <Enter>

But if you want the new setting to be a default, write it to NVRAM at the same time, as in the following example. X7 is substituted for the X*n* value stored earlier. Any other setting that was changed and can be saved to NVRAM will also be saved.

AT X7 &W <Enter>

Resetting the Modem

Z — Software reset to NVRAM settings when DIP switch 10 is OFF (factory setting). If DIP switch 10 is OFF, the modem resets to the &F0 configuration template, with no flow control.

NOTE: Use the ATZ command also if you've changed the position of DIP switches 1–7 or 9 while the modem is on, so that the modem can read the new setting. The only other way to initiate a new setting for switches 1–7 and 9 is to turn the modem off and on again.

CONFIGURATION

Echo/Speaker

E*n* — Command mode local echo. Enables/disables the display of your typed commands. If double characters appear on the screen, both the modem's local echo and your software's local echo are on.

The Courier is shipped with DIP switch 4 OFF, enabling local echo. The E*n* command controls the local echo for a current session, independently of the switch setting. At power-on and reset, the modem operates according to the DIP switch setting. The E*n* command is not stored in nonvolatile memory as a power-on/reset default.

E0 Command mode echo OFF. The modem does not display keyboard commands.

E1 Command mode echo ON.

F*n* Online local echo. This command causes the modem to display a copy of the data it is transmitting to another system. Many systems, however, return a copy of received data, which is called a remote echo. If the modem's online echo is ON and there is also remote echoing, double characters appear on the screen.

In some microcomputer documentation, the term *duplex* is applied to local online echoing, although the term is not technically accurate.

F0 Online echo ON. Sometimes called *half duplex*. As the modem transmits data to a remote system, it also sends a copy of the data to the screen.

F1 Online echo OFF. Sometimes called *full duplex*. Default.

M*n* Speaker (audio monitor).

M0 The speaker is always OFF.

M1 The speaker is ON until carrier is established (Default).

M2 The speaker is always ON, including during data transfer.

M3 The speaker is ON after the last digit is dialed and remains ON until carrier is established.

Result Codes

Qn Enable/suppress the display of result codes. The Courier is shipped with DIP switch 3 ON, to display result codes. Use the *Qn* command to control the display for a current session, independently of the switch setting.

At power-on and reset, the modem operates according to the DIP switch setting. The *Qn* command is not stored in non-volatile random access memory.

Q0 Result codes displayed.

Q1 Result codes suppressed (quiet).

Q2 Result codes suppressed in Answer mode.

Vn Return result codes in words or numbers (Verbal/Numeric mode). At power-on and reset, the modem operates according to the DIP switch setting. The *Vn* command is not stored in nonvolatile memory as a power-on/reset default.

V0 Numeric mode.

V1 Verbal mode.

Xn Result code set options. Use the following table (Default = X7, all codes except 12/VOICE). For result codes in synchronous operations, see Appendix I.

	Setting							
Result Codes	**X0**	**X1**	**X2**	**X3**	**X4**	**X5**	**X6**	**X7**
0/OK	•	•	•	•	•	•	•	•
1/CONNECT	•	•	•	•	•	•	•	•
2/RING	•	•	•	•	•	•	•	•
3/NO CARRIER	•	•	•	•	•	•	•	•
4/ERROR	•	•	•	•	•	•	•	•
5/CONNECT 1200		•	•	•	•	•	•	•
6/NO DIAL TONE			•		•		•	•
7/BUSY				•	•	•	•	•
8/NO ANSWER				•	•	•	•	•
9/RESERVED								
10/CONNECT 2400		•	•	•	•	•	•	•
11/RINGING						•	•	•
12/VOICE						•	•	
13/CONNECT 9600		•	•	•	•	•	•	•
18/CONNECT 4800		•	•	•	•	•	•	•
20/CONNECT 7200		•	•	•	•	•	•	•
21/CONNECT 12000		•	•	•	•	•	•	•
25/CONNECT 14400		•	•	•	•	•	•	•
47/CONNECT 16800		•	•	•	•	•	•	•
59/DATA	•	•	•	•	•	•	•	•
60/FAX	•	•	•	•	•	•	•	•
85/CONNECT 19200		•	•	•	•	•	•	•
91/CONNECT 21600		•	•	•	•	•	•	•
Functions								
Adaptive Dialing			•	•	•	•	•	•
Wait for 2nd Dial Tone (W)				•	•	•	•	•
Wait for Answer (@)				•	•	•	•	•
Fast Dial			•		•		•	•

Table 4-1. Result Code Options

NOTE: Additional messages indicate an error control connection and the modulation for a call. See the *Additional Result Codes* that follow.

Result Code	Meaning
0/OK	Command has been executed.
1/CONNECT	Connection with another modem; if set to X0, connection may be between 300 and 21.6 bps; if X1 or higher, connection is at 300 bps.
2/RING	Incoming ring detected.
3/NO CARRIER	Carrier detect has failed or carrier has been dropped due to disconnect.
4/ERROR	Command is invalid.
5/CONNECT 1200	Connection with another modem at 1200 bps.
6/NO DIAL TONE	Dial tone not detected during the normal 2 seconds, set in Register S6.
7/BUSY	Busy signal detect; modem hangs up.
8/NO ANSWER	After waiting 5 seconds for an answer, modem hangs up; returned instead of NO CARRIER when the @ option is used.
10/CONNECT 2400	Connection with another modem at 2400 bps.
11/RINGING	The modem has dialed; remote phone line is ringing.
12/VOICE	Voice answer at remote site; modem hangs up.
13/CONNECT 9600	Connection at reported rate. Same meaning for results of 4800 (18), 7200 (20), 12K (21), 14.4K (25), 16.8K (43), 19.2K (85), or 21.6K (91).
59/DATA	The modem detects incoming call as Data. Only if Call Selection is enabled.
60/FAX	The modem detects incoming call as Fax. Only if Call Selection is enabled.
Adaptive Dialing	The modem attempts to use tone dialing and, if that doesn't work, reverts to rotary dialing.
Wait for Another Dial Tone (W)	The modem continues dialing as soon as it detects another dial tone. See the dial options earlier in this chapter.
Wait for an Answer (@)	The modem continues dialing when it detects 5 seconds of silence on the line. See the dial options earlier in this chapter.
Fast Dial	The modem dials immediately on dial-tone detect, instead of waiting the normal 2 seconds set in Register S6.

Table 4-2. Result Code Definitions

Additional Result Code Subsets

NOTE: *ARQ* (Automatic Repeat Request) is used in this manual to denote calls under error control.

&A*n* Enable/disable additional result code subsets. See the X*n* command earlier in this chapter.

&A0 ARQ result codes are disabled. This setting does not affect an error control connection; the modem returns the standard CONNECT messages if result codes are enabled.

&A1 ARQ result codes are enabled, indicating that a connection is under error control. Message 14 is displayed if the modem is set to X0 and the connection is at any rate from 1200 to 21.6K bps. The remaining results indicate the connection rate and require a setting of X1 or higher.

14/CONNECT/ARQ
15/CONNECT 1200/ARQ
16/CONNECT 2400/ARQ
17/CONNECT 9600/ARQ
19/CONNECT 4800/ARQ
22/CONNECT 12000/ARQ
24/CONNECT 7200/ARQ
26/CONNECT 14400/ARQ
47/CONNECT 16800/ARQ
88/CONNECT 19200/ARQ
94/CONNECT 21600/ARQ

&A2 Additional HST or V32 modulation indicator. Included for users of HST Dual Standard modems. If your software cannot handle the added modulation information, select &A1 or &A0.

23/CONNECT 9600/HST	or	33/CONNECT 9600/V32
27/CONNECT 9600/ARQ/HST	or	37/CONNECT 9600/ARQ/V32
28/CONNECT 4800/HST	or	38/CONNECT 4800/V32
29/CONNECT 4800/ARQ/HST	or	39/CONNECT 4800/ARQ/V32
30/CONNECT 7200/HST	or	40/CONNECT 7200/V32
34/CONNECT 7200/ARQ/HST	or	44/CONNECT 7200/ARQ/V32
31/CONNECT 12000/HST	or	41/CONNECT 12000/V32
32/CONNECT 12000/ARQ/HST	or	42/CONNECT 12000/ARQ/V32
35/CONNECT 14400/HST	or	45/CONNECT 14400/V32
36/CONNECT 14400/ARQ/HST	or	46/CONNECT 14400/ARQ/V32
47/CONNECT 16800/HST	or	83/CONNECT 16800/V32
47/CONNECT 16800/ARQ/HST	or	57/CONNECT 16800/ARQ/V32
88/CONNECT 19200/ARQ	or	87/CONNECT 19200/V32
	or	90/CONNECT 19200/ARQ/V32
94/CONNECT 21600/ARQ	or	93/CONNECT 21600/V32
	or	96/CONNECT 21600/ARQ/V32

&A3 Additional error control indicator (LAPM, HST, MNP, SYNC, or NONE) and data compression type (V42BIS or

MNP5). Default. When the call is not under one of those protocols (and ARQ is not included in the result code), the modem reports either SYNC, indicating a synchronous connection, or NONE, for no protocol.

If the modems are using data compression, the type of compression, V42BIS or MNP5, is added to the result code. In the first of the following examples, the modems negotiated error control for the call (ARQ), used V32 modulation, are using the LAPM error control protocol, and are using V.42 *bis* compression.

```
CONNECT 21600/ARQ/V32/LAPM/V42BIS [or MNP/MNP5]
CONNECT 19200/ARQ/V32/LAPM/V42BIS [or MNP/MNP5]
CONNECT 19200/SYNC
CONNECT 16800/ARQ/V32/LAPM/V42BIS [or MNP/MNP5]
CONNECT 16800/ARQ/HST/HST/V42BIS [or MNP/MNP5]
CONNECT 16800/SYNC
CONNECT 14400/SYNC
CONNECT 12000/ARQ/HST/HST/CELLULAR/V42BIS [or MNP5]
CONNECT 12000/SYNC
CONNECT 9600/SYNC
CONNECT 2400/ARQ/MNP/MNP5 [or LAPM/V42BIS]
CONNECT 2400/NONE
```

NOTE: Although these codes will return numeric identifiers, they are the same numeric identifiers used for &A2 result codes. If the modem is in Numeric mode (V0) and set to &A3, you will not be able to differentiate between &A2 and &A3 result codes. &A3 result codes may not be compatible with some software.

Modulation

B*n* Handshake options. There are three commands that apply to international calls above 1200 bps—B*n*, &G*n*, &P*n*. See **International Calls** later in this chapter for information on the other two settings.

B0 ITU-T (formerly CCITT) answer sequence. Default. This is required to answer all V.32-type calls as well as calls from overseas.

B1 Bell answer tone. This setting selects HST modulation in Dual Standard modems; but should only be used if the modem is not required to answer V.32-type calls, because

it sends the wrong answer tones. **NOTE:** This setting is used for HST cellular calls.

Error Control/Data Compression

&M*n* Enable ARQ (error control) or synchronous protocols. Both your modem and the remote modem must use the same protocol.

- &M0 Normal mode, no error control. Due to the nature of phone line channels, this is never recommended for calls above 2400 bps.
- &M1 This setting is exclusive of the modems' error control and is used only for online synchronous mode without V.25 *bis*. See Appendix E for more information .
- &M2 Reserved.
- &M3 Reserved.
- &M4 Normal/ARQ mode. Default. If an ARQ connection isn't made, the modem operates in Normal mode, as though it were set to &M0.

  NOTE: V.32-type modems reverting to Normal mode transfer data at high speeds without the reliability of error control. To avoid this, these modems, local and remote, should always be set for error control. Modems in HST mode, if unable to establish an error control connection, drop to 2400 bps.
- &M5 The modem enters ARQ asynchronous mode. The modem hangs up if an ARQ connection cannot be made.
- &M6 The modem enters V.25 *bis* synchronous mode, using a character-oriented link protocol similar to BISYNC. See Appendix E for more information
- &M7 The modem enters V.25 *bis* synchronous mode, using the HDLC link protocol.

&K*n* Enable/disable data compression.

- &K0 Data compression disabled.
- &K1 Auto enable/disable. Default. The modem enables compression if the serial port rate is fixed, &B1, and disables compression if the serial port rate follows the connection rate, &B0, because compression offers no

throughput advantage when the serial port and connection rates are equal: compression may even degrade throughput.

&K2 Data compression enabled. Use this setting to keep the modem from disabling compression.

&K3 Selective data compression. The modem negotiates only for V.42 *bis* compression, and disables MNP Level 5 (MNP5) compression. Use this setting to transfer 8-bit binary files, .ZIP files, and other files that are already compressed. See the note below.

NOTE: MNP5 compression is not useful when transferring files that are already compressed, such as the .ZIP files downloaded from many Bulletin Boards and 8-bit binary files, which appear to the modem to be compressed. MNP5 tends to add data to the transmission so that throughput over the link degrades. V.42 *bis* compression dynamically detects when data is already compressed and turns off until it detects that compression will work to advantage. The special &K3 setting enables the best throughput for already-compressed files.

See *Throughput Guidelines* and *Data Compression* in Appendix A for more information, including throughput to expect for different kinds of files.

Data Rates

The modem can be set to a fixed or variable serial port rate. A fixed rate sets the modem for the highest possible throughput and provides the best performance. A variable rate allows the modem to switch to match the more limited rate on the phone connection.

Your software must support fixed or variable serial port rates, and must be set to either of the two settings. **NOTE:** Your software may refer to these options with terms like *locked serial port* (fixed rate) or *autobaud* (variable rate).

Most communications programs support variable rates, but not all software supports fixed rates.

WARNING: To connect above 9600 bps, the serial port rate must be 19.2K, 38.4K, 57.6K, or 115.2K bps. If the local computer is limited to 9600 bps, V.32 *terbo* modems are limited to 9600 bps

maximum, that is, V.32. Disable V.32 *terbo* modulation so that the modem does not switch its serial port rate up higher than 9600 bps. Do this by setting Register S34 to 3 (S34=3) and including that setting in the defaults you write to nonvolatile memory, as shown in **Setting/Using Defaults** earlier in this chapter.

&B*n* Serial port rate variable or fixed.

&B0 Variable rates. When the modem switches its connection rate to connect with a modem operating at a different rate, it also switches its serial port rate. The software or terminal also switches serial port rates to match the connection rate.

&B1 Fixed rate. Default. The modem always communicates with the terminal or computer at the rate at which you have set the terminal or software, regardless of the connection rate. For the greatest throughput, set the serial port to 115.2K, 57.6K, 38.4K bps for high speed calls and to at least 9600 bps for 2400-bps calls.

This setting is not affected by the &N setting. However, the serial port rate *must be equal to or higher than* the &N*n* rate.

&B2 Fixed for ARQ calls/Variable for non-ARQ calls. Answer mode only. When the modem goes off hook and connects in ARQ mode, it shifts its serial port rate up to a user-specified rate, for example, 38.4K bps. If the connection is not under error control, the modem behaves as if it were set to &B0 and switches its serial port rate to match the connection rate of each call.

This option is designed for installations such as Bulletin Boards that receive calls from a wide variety of modems, ranging from the very slow to those with the Courier's advanced design.

To implement this feature, first set your software to the desired rate. Then send the modem the **AT &B2 [other settings] &W** command.

The modem stores the rate of the command in NVRAM along with the settings. Each time it makes an ARQ connection, the modem checks NVRAM for the specified serial port rate.

When sending subsequent configurations to NVRAM, be sure your software is set to your selected serial port rate, so that the correct rate is maintained.

&N*n* Connection rate variable or fixed.

&N0 Variable rates. Default. The Courier negotiates with the remote modem for the highest possible connection rate, depending on the capabilities of the remote modem. This is the recommended setting, and *is required* for the Courier V.32 *terbo* to connect at 21.6K bps. Both modems must be U.S. Robotics modems with V.32 *terbo* to make a 21.6K bps connection.

&N1-&N10 Fixed rate. The modem only connects if the remote modem is operating at the same rate. If not, the modem hangs up. If you wish, you can filter out calls at other than a specific rate, for security or other reasons, by fixing the connection rate.

The connection rate must always be lower than, or equal to, the serial port rate, never higher.

The options are as follows.

&N1	300 bps	&N7	12K bps
&N2	1200 bps	&N8	14.4K bps
&N3	2400 bps	&N9	16.8K bps (HST–to–HST or *terbo*–to–*terbo* only)
&N4	4800 bps		
&N5	7200 bps	&N10	19.2K bps (*terbo*–to–*terbo* only)
&N6	9600 bps		

RS-232 Signal Operations

&C*n* Carrier Detect operations. At power-on and reset, the modem operates according to the setting of DIP switch 6. This command is not stored in nonvolatile memory as a power-on/reset default.

&C0 CD override, CD always ON.

&C1 Normal CD operations. The Courier sends a CD signal when it connects with another modem and drops the CD when it disconnects.

&D*n* Data Terminal Ready (DTR) operations. At power-on and reset, the modem operates according to the setting of DIP switch 1. This command is not stored in nonvolatile memory as a power-on/reset default.

&D0 DTR override. The modem operates as though the DTR is always ON.

&D1 Advance usage: If issued before connecting with another modem, the modem can enter online command mode during a call by toggling DTR. (Most communications software packages have a method for toggling DTR.) &D1 functions similarly to the escape code (+++), except that this setting is independent of DIP switch 9.

If DIP Switch 1 is ON (DTR override) when you issue the &D1 command, the DTR override is automatically turned off. However, if you change the setting of DIP switch 1 *after* issuing &D1, the DIP switch setting takes precedence.

Return online with the O*n* command, or hang up with the H*n* command.

&D2 Normal DTR operations. The terminal or computer must send a DTR signal for the modem to accept commands. Dropping DTR terminates a call.

&S*n* The modem sends the computer or terminal a Data Set Ready (DSR) signal via the RS-232 interface. (Data Set is industry jargon for modem.) Few, if any, commercial communications programs require the modem to control DSR, &S1. Leave the modem set for DSR overridden, &S0, unless you know that your installation requires a different setting.

&S0 DSR is always ON (override). Default.

&S1 In Originate mode, the modem sends the DSR after it dials, when it detects the remote modem's answer tone. In Answer mode, the modem sends the DSR after it sends an answer tone.

&S2 This option is for specialized equipment such as automatic callback units. On loss of carrier, the modem sends a pulsed DSR signal with Clear to Send (CTS) following Carrier Detect (CD).

&S3 This is the same as &S2, but without the CTS following CD.

&S4 The modem sends the computer a DSR signal at the same time as it sends the Carrier Detect (CD).

Flow Control

Flow control allows the modem to monitor the amount of data coming from the computer or the remote modem, and notify either end if its buffers are too full, so that they stop sending data for a moment.

The modem uses either hardware or software flow control. Your software and machine must support whichever type you select.

Hardware Control

The modem drops the Clear to Send (CTS) signal it's been sending to the computer or terminal when the modem's buffer nears 90% capacity. It starts sending CTS again when the buffer is about half full.

Software Control

The modem sends the computer or terminal the standard ASCII Transmit OFF (XOFF) character, <CTRL-S>, when its buffer nears 90% capacity. The modem sends the ASCII Transmit ON character, <Ctrl>-Q, when the buffer is about half full. ASCII definitions are as follows:

XON <Ctrl>-Q (ASCII 17 Decimal, 11 Hex)
XOFF <Ctrl>-S (ASCII 19 Decimal, 13 Hex)

NOTE: You should set your software as well to either hardware or software flow control. Some programs also require that you turn off the type you are not using.

The ASCII characters may be user-defined. See Registers S22 and S23 in Appendix B. That appendix also includes an ASCII chart.

WARNING: If possible, always use hardware flow control, the factory default. You may lose data if XON/XOFF (Ctrl-S, Ctrl-Q) characters occur in the data stream from other sources. They may, for example, come from the remote system: an XON from the remote system, after your modem has sent an XOFF, can result in buffer overflow.

Ctrl-S (XOFF) and Ctrl-Q (XON) characters also occur in binary files, and are used by Xmodem-type protocols. You risk having these characters misinterpreted as modem flow control characters and dropped from the data stream.

If you cannot use hardware flow control and if you're transferring non-text (binary) files, or using an Xmodem-type protocol, disable flow control entirely (&H0). In addition, be sure the modem is set to &B0 and &N0, so that the serial port and connection rates are equal.

Transmit Data Buffer Sizes

The Transmit Data refers to the data from the computer, which the modem is to transmit over the phone line.

The size of the Transmit data buffer depends on whether the connection is under error control or not, as follows.

- ARQ connections: 3.25K bytes.
- Non-ARQ connections: 1.5K bytes, allowing use of error control file transfer protocols such as Xmodem and Ymodem without flow control.

If bit 3 of Register S15 is turned on, the non-ARQ buffer size is reduced to 128 bytes, for the convenience of BBS operators taking calls from remote users of slower modems. See *S-Register Summary*, S15, in Appendix B.

Received Data Buffer Size

Received Data refers to the data the modem has received over the phone link, which the modem is to pass on to its attached computer.

The size of this buffer remains constant at 2K bytes.

Transmit Data Flow Control

&H*n* This type of flow control is for data transmitted to the modem by its attached computer or terminal. The modem monitors its buffer as data comes from the computer or modem. If the buffer approaches 90% capacity, the modem signals the computer or terminal to stop transmitting. When the modem has sent enough data over the link to half empty the buffer, it signals the computer or terminal to resume transmitting.

&H0 Transmit Data flow control disabled.

&H1 Hardware flow control. Default. Requires that your computer or terminal and software support Clear to Send (CTS) at the RS-232 interface.

&H2 Software flow control. Requires that your software support XON/XOFF signaling.

&H3 Use both hardware and software flow control. If you are unsure about what your equipment supports, select this option. But keep the warning, above, in mind about software flow control.

Received Data Flow Control

Separate commands, &R*n* (hardware) and &I*n* (software), control the flow of Received Data passed by the Courier to your computer or terminal.

Your software and machine must support whichever type you select, although we recommend hardware flow control, if possible.

Hardware Control(&Rn)

&R0 Delay Clear to Send Response after Request to Send signal (RTS/CTS delay). The delay is required by some synchronous mainframes and does not apply to asynchronous calls.

&R1 The modem ignores RTS. This setting is required if your computer or terminal or software does not support RTS.

&R2 Hardware flow control of received data enabled. Default. The modem sends data to the computer or terminal only on receipt of the RTS signal.

Software Control (&In)

WARNING: In ordinary operation, the only characters the modem recognizes during a call are the three pluses (+++) of the escape code. But when software flow control is enabled, the modem also looks for <Ctrl>-S or <Ctrl>-Q characters. If these characters occur in a file or as part of a protocol, the modem reads them as XON/XOFF characters and acts on them. In some cases, the modem drops them from the data stream.

&I0 Disables XON/XOFF flow control of received data. Default. Recommended for non-ARQ (Normal mode) calls, but see &I5. The I0 option provides transparency for

all characters except the escape code sequence (+++), because at this setting the modem does not look for control characters.

NOTE: Because of the risk described in the above warning, the settings that follow are only recommended for users whose data does not include XON/XOFF control characters.

&I1 The Courier acts on your typed XON/XOFF commands, Ctrl-S or Ctrl-Q, and passes them to the remote computer. Use in ARQ mode only, but keep in mind that the XON/XOFF characters sent to the remote computer may interfere with XON/XOFF signaling between the remote computer and remote modem. See &I2.

&I2 The Courier acts on your XON/XOFF commands, but removes them from the data stream instead of passing them to the remote computer. This ensures that the remote computer does not confuse your XON/XOFF characters with those from its attached modem. This is the recommended setting for ARQ mode.

However, if the call is not in ARQ mode, there is no flow control on the phone link. If you send an XOFF to your modem and it stops passing data, it has no way to tell the remote computer and modem to stop sending for a while, and your modem's buffer may overflow. For more reliable control in non-ARQ mode, see &I5.

&I3 Hewlett Packard—Host mode. Applies only to modems attached to an HP mainframe that uses the ENQ/ACK protocol. Use in ARQ mode only. See Appendix F.

&I4 Hewlett Packard—Terminal mode. Applies only to modems attached to terminals in an HP system that uses the ENQ/ACK protocol. Use in ARQ mode only. See Appendix F.

&I5 This setting is designed to enable flow control on the phone link when the connection is not under error control. For this to work for you, the remote modem must have &I5 capability.

In ARQ mode, a Courier set to &I5 operates the same as it does when set to &I2. It acts on your XON/XOFF commands, but does not pass them to the remote system. The

error control protocol enables the modems to control the flow of data on the phone link.

In non-ARQ mode, a Courier set to &I5 operates as though flow control were disabled (&I0): it does not look for your typed XON/XOFF commands. However, it looks for XON/XOFF characters *coming in over the phone link*. When the remote operator sends XON/XOFF commands, the Courier either resumes or stops transmitting data over the link and drops the characters from the data stream.

If both modems are set to &I5, operators at each end can signal the remote modem to stop sending, thereby controlling the data flow on the phone link and preventing their own modem's buffer from overflowing. At the computer or terminal/modem interfaces, the modems independently control the flow of data through their Transmit Data (&H) settings.

Guidelines

Use of software flow control may prove satisfactory if you're only transferring text files. However, if you're transferring non-text (binary) files, or using an Xmodem-type protocol, disable flow control entirely (&R1, &I0). In addition, set the modem to &B0 and &N0, so that the serial port and connection rates are equal.

S-REGISTERS

The S-Registers are used to set various timing parameters, redefine selected ASCII characters, and other configuration options. A detailed summary of the S-register functions is in Appendix B. A less detailed summary is in the Quick-Reference card.

S*r*=*n* Set S-Register value: *r* is any S-Register; *n* must be a decimal number between 0 and 255.

S*r*.*b*=*n* Alternative command for setting bit-mapped registers: *r* is the bit-mapped register; *.b* is the bit; *n* is 0 (off) or 1 (on).

S*r*? Query contents of register *r*.

INQUIRY AND HELP

The modem displays information such as the current modem settings, product code, and call duration. It also displays summary information for every command that the modem supports.

For more information on Inquiry and Help commands, including sample displays, see Chapter 5.

TESTING

The modem can perform a number of tests including, Analog Loopback, Digital Loopback, and Remote Digital Loopback. These tests can be used to check the operations of the modem's transmitter and receiver, or to locate a problem with a remote modem or telephone channel. Error control must be disabled for these tests.

See Appendix G for more information.

INTERNATIONAL CALLS

There are three commands that apply to international calls above 1200 bps—B*n*, &G*n*, &P*n*. B*n* is described earlier in this chapter.

&G*n* This setting applies only to overseas calls at 2400 or 1200 bps. British phone switching systems require the modem to send an 1800 Hz guard tone after it sends an answer tone. Some other European phone networks require a 550 Hz guard tone. Guard tones are not used in the United States or Canada.

- &G0 No guard tone. This is used in the U.S. and in Canada (Default).
- &G1 This sets a 550 Hz guard tone, and is used in some European countries.
- &G2 This sets an 1800 Hz guard tone, and is used in the U.K., and some Commonwealth countries. &G2 requires the B0 setting.

&P*n* This command sets the ratio of the off-hook/on-hook (make/break) interval for pulse dialing. The default sets the modem for use in North America. The ratio must be changed if the modem is used in the United Kingdom and some Commonwealth countries.

&P0 Make/break ratio, U.S./Canada: 39%/61%. Default.

&P1 Make/break ratio, United Kingdom, some Commonwealth countries: 33%/67%.

MISCELLANEOUS COMMANDS

C*n* Transmitter enabled/disabled.

C0 Transmitter disabled; receive-only condition.

C1 Transmitter enabled (Default).

K*n* Modem clock operation: Call-duration or Real-time mode. Displayed with ATI3 and ATI6 commands.

K0 Display current call-duration if online. Display last call-duration if offline. Default.

K1 Return actual time at ATI3. Clock is set using ATI3=HH:MM:SS K1.

&Y*n* Break handling. This command allows you to send a break to abort data transfer without disconnecting from the phone link.

&Y0 Destructive, don't send Break.

&Y1 Destructive, expedited (Default).

&Y2 Nondestructive, expedited.

&Y3 Nondestructive, unexpedited; modem sends Break in sequence with data received from computer or terminal.

NOTE: If the call is under MNP5 data compression, destructive Breaks cause both modems to reset their data compression tables. When transmission resumes, the modems build new tables, and the result is lower than normal throughput.

&ZC=*s* Write the following command string *s* to NVRAM. The command string may be up to 30 characters long; spaces are not counted. This command can be used so that you can call another modem without loading your communications software.

After storing a command, you can program the voice/data switch to execute the stored command string when pressed. The following example assigns a command string that displays the link diagnostics screen when you press the voice/data switch.

AT&ZC=I6 <Enter>

The function of the voice/data switch is determined by the setting of Register S32, as described in Appendix F. Set the voice/data switch function to *execute stored command string* by setting Register S32 to 9 with the following command.

ATS32=9 <Enter>

Note that you can reset the voice/data switch at any time to one of the other available functions. Additionally, you can overwrite the stored command string with a new one at any time.

Once you've stored your command string and set Register S32, all you need to do is press the voice/data switch whenever you want the command string executed.

&ZC? Display the stored command string.

%R*n* If the modem is part of a U.S. Robotics Total Control Modem Management System, setting the modem to %R1 allows an operator to use the modem to call a Rack Controller Unit (RCU) at a remote site.

%R0 Normal operations, RCU access disabled. Default.

%R1 RCU access enabled.

%T Enables the modem, when off hook, to detect the tone frequencies of dialing modems. %T is meant primarily for use with network applications, but may also be integrated into certain software programs. For example, %T could be used in a security program to identify incoming tone security codes.

To enable %T, type ATH1 <Enter> to force the modem off hook. Then type AT%T <Enter>.

To return the modem to Command mode, press any key or drop the computer's or terminal's DTR signal. The modem responds OK.

CHAPTER 4. FAX OPERATIONS AND CALL SELECTION

FAX OPERATIONS

Compatibility

The Courier modem provides Group III-compatibility when combined with Class 1 or Class 2.0 fax software. In addition, the modem adheres to the following standards.

NOTE: The International Telecommunication Union (ITU-T) was formerly the International Telegraph and Telephone Consultative Committee (CCITT).

TIA/EIA-578	Service Class 1 Asynchronous Facsimile DCE Control Standard
TIA/EIA-592	Service Class 2.0 Asynchronous Facsimile DCE Control Standard
ITU-T V.17	14.4K/12K bps
ITU-T V.29	9600/7200 bps
ITU-T V.27 *ter*	4800/2400 bps
ITU-T V.21	300 bps

Fax Modem Guidelines

Fax operations require facsimile-compatible software that can send or receive Group III faxes. Follow the instructions in your fax software manual.

The modem's normal operating mode is Data mode. If your fax software is typical, it automatically switches the modem to Fax mode when you run the program, and resets the modem to Data mode when you exit the program.

If you have a problem, however, and think the modem may be in the wrong mode, you can use one of the following AT commands to manually switch the modem:

AT+FCLASS=0 (Switch to Data mode)
AT+FCLASS=1 (Switch to Class 1 Fax mode)
AT+FCLASS=2.0 (Switch to Class 2.0 Fax mode)

If you are not sure whether the modem is in Data or Fax mode, type the following command.

AT+FCLASS?

The modem returns a value of 0 to indicate Data mode, 1 to indicate Class 1 Fax mode, or 2.0 to indicate Class 2.0 Fax mode.

NOTE: Whenever the fax modem is reset using the ATZ command, by toggling the DTR signal, or by turning the power off and on, the modem will be set to Data mode.

Fax Mode Flow Control Setting

Many facsimile software products use software flow control when the modem is in Fax mode. Throughout our documentation, we recommend that you set your modem for hardware flow control for Data mode. However, to allow compatibility with software products that use software flow control by default, U.S. Robotics fax modems now automatically change to software flow control when entering Fax mode.

FCC Notice

FCC part 68, rules regarding fax operation, has been amended as follows:

> Telephone facsimile machines—identification of the sender of the message: It shall be unlawful for any person within the United States to use a computer or other electronic device to send any message via a telephone facsimile machine unless such a message clearly contains, in a margin at the top or bottom of each transmitted page or on the first page of the transmission, the date and time it is sent and an identification of the business, other entity, or individual sending the message and the telephone number of the sending machine or of such business, other entity, or individual. Telephone facsimile machines manufactured on and after December 20, 1992 must clearly mark such identifying information on each transmitted page.

A NOTE TO PROGRAMMERS

If you want to know more about the supported Class 1 fax commands, refer to the standard for the Service Class 1 fax protocol.

ANSI/EIA/TIA-578-1990 (EIA-578)
Asynchronous Facsimile DCE Control Standard
November, 1990 Approved: October 22, 1990

You can obtain a copy of this standard by contacting Global Engineering Documents, at 1-800-854-7179.

For more information on supported Class 2.0 fax commands, refer to the standard for the Service Class 2.0 fax protocol.

ANSI/EIA/TIA-592-1993 (EIA-592)
Asynchronous Facsimile DCE Control Standard
May, 1993

CALL SELECTION

Incoming Fax/Data Reporting

By default, your modem operates in Data mode under the control of your communications software. When you load your fax software, however, it puts the modem in Fax mode by issuing a transparent AT+FCLASS command. Some fax software also automatically enables Call Selection, but typically the default of Call Selection disabled is the rule.

Detecting a Fax Call

Class 1

When your modem is set to answer mode and it receives a call, and Call Selection is enabled, it goes off hook and searches for a fax calling tone. If a Class 1 fax calling tone is detected, the modem sends a FAX message to your computer before it sends a CONNECT message.

In response to the CONNECT result code, the software negotiates a connection in Fax mode. If the fax calling tone is not detected, the normal Data mode answer tones are sent to the

computer and the modem turns control over to the Data mode software.

NOTE: Any character from the computer in response to the CONNECT message will cause the modem to go online. We recommend that Register S19 be set to 3 to prevent the modem from remaining online if the software does not properly distinguish between a FAX response and an inadvertent key stroke.

Class 2.0

When your modem is set to answer mode and receives a call, and Call Selection is enabled, it searches for a fax calling tone. If a Class 2.0 fax calling tone is detected, the modem sends a +FCO message to your computer before it sends a CONNECT message.

In response to the CONNECT result code, the software negotiates a connection in Fax mode. If the fax calling tone is not detected, the normal Data mode answer tones are sent to the computer and the modem turns control over to the Data mode software.

Detecting a Data Call—Class 1, Class 2.0

If a connection is established in Data mode, the modem sends one of two data messages to the computer. If it is a Class 1 data call a DATA message is sent. If it is a Class 2.0 data call, a +FDM message is sent. The computer then sends an initialization string, followed by a command that tells the modem to issue the CONNECT message.

Call Type	Fax S/W	Result Code
Data	Class 1	DATA CONNECT
Data	Class 2.0	+FDM CONNECT
Fax 1.0	Class 1	FAX CONNECT
Fax 2.0	Class 2.0	+FCO CONNECT

Table 4.1 Call Selection Enabled Results

Disabling Call Selection

To disable Call Selection, and answer a fax transmission of a specific type (Class 1 or Class 2.0), type the following command.

AT+FAA=0 <Enter>

If the fax software is Class 2.0, and the modem is set for +FAA=0, the modem will only answer Class 2.0 faxes.

If the fax software is Class 1, and the modem is set to +FAA=0, the modem will only answer Class 1 faxes.

Call Type	Fax S/W	Result
Data, Fax Class 2.0	Class 1	Modem hangs up
Data, Fax Class 1	Class 2.0	Modem hangs up
Fax 1	Class 1	Modem answers, sends CONNECT message
Fax 2.0	Class 2.0	Modem answers, sends +FCO message

Table 4.1 Call Selection Disabled Results

Re-enabling Call Selection

To reset the modem to Call Selection and answer Class 1 or Class 2.0 fax transmissions, type the following command.

AT+FAA=1 <Enter>

By re-enabling Call Selection, the modem can answer Fax or Data calls.

Call Selection Query

Type the following command if you are not sure if Call Selection is enabled.

AT+FAA? <Enter>

If the modem returns a value of 0, Call Selection is disabled.

If the modem returns a value of 1, Call Selection is enabled.

The AT+FAA commands are only valid when the modem is in Class 1 (+FCLASS=1) or Class 2.0 (+FCLASS=2.0) mode. If the

modem is in Data mode (+FCLASS=0) and an +FAA command is issued, an ERROR message will be displayed.

For a list of additional +FCLASS commands supported by U.S. Robotics, see Appendix I, *Technical Specifications*.

CHAPTER 5. QUERIES AND HELP SCREENS

USER INQUIRIES (In)

The Inquiry command has 9 options. The most commonly used options display the following information:

ATI3	Call duration
ATI4	Current settings
ATI5	NVRAM settings
ATI6	Link diagnostics summary

I0 The modem returns a 4-digit product code. If you have a problem and call U.S. Robotics' Technical Support Department, you may be asked for this product code.

I1 The modem performs a checksum of its read-only memory (ROM) and returns the result to the screen. This function is used only in factory testing. The modem should always read the same number.

I2 The modem performs a test of its random access memory (RAM) and returns either the OK (0) or ERROR (4) result code, followed by OK when the test is completed. You may want to use this command as a checkpoint if the modem appears to be malfunctioning.

I3 The modem returns the duration of the last call if set to K0. It displays the actual time if set to K1. See the description of the K*n* command in Chapter 3.

I4 The modem displays its current configuration. Figure 5.1 on the following page is an example.

```
ati4
USRobotics Courier HST Dual Standard Terbo Fax Settings...

   B0  C1  E1  F1  M1  Q0  U1  X1
   BAUD=19200 PARITY=N  WORDLEN=8
   DIAL=PULSE  ON HOOK   TIMER

   &A3  &B1  &C1  &D2  &G0  &H1  &I0  &K1  &L0  &M4  &N0
   &P0  &R2  &S0  &T5  &X0  &Y1  %M6  %R0

   S00=001  S01=000  S02=043  S03=013  S04=010  S05=008  S06=002  S07=060
   S08=002  S09=006  S10=007  S11=070  S12=050  S13=000  S14=001  S15=000
   S16=000  S17=000  S18=000  S19=000  S20=000  S21=010  S22=017  S23=019
   S24=150  S25=005  S26=001  S27=000  S28=008  S29=020  S30=000  S31=000
   S32=009  S33=000  S34=000  S35=000  S36=000  S37=000  S38=000  S39=000
   S40=000  S41=000  S42=126  S43=200  S44=015  S45=000  S46=000  S47=000
   S48=000  S49=000  S50=000  S51=000  S52=000  S53=000

   LAST DIALED #:

OK
```

Figure 5.1—Sample Result of ATI4 Command

I5 The modem displays the configuration stored in nonvolatile random access memory (NVRAM), as in the following example. If your modem connects to a modem that has Dial Security and local access enabled, you cannot view the stored phone numbers.

```
ati5
USRobotics Courier HST Dual Standard Terbo Fax Settings...

   DIAL=TONE   B0  F1  M1  X1
   BAUD=38400  PARITY=N  WORDLEN=8

   &A3  &B1  &G0  &H1  &I0  &K1  &L0  &M4  &N0
   &P0  &R2  &S0  &T5  &X0  &Y1  %M6  %R0

   S00=001  S02=043  S03=013  S04=010  S05=008  S06=002  S07=060  S08=002
   S09=006  S10=007  S11=055  S12=050  S13=000  S15=000  S19=000  S21=010
   S22=017  S23=019  S24=150  S25=005  S26=001  S27=000  S28=008  S29=020
   S31=000  S32=009  S33=000  S34=000  S35=000  S36=000  S37=000  S38=000
   S39=000  S40=000  S41=000  S42=126  S43=200  S44=015  S51=000  S53=000

                        STORED PHONE NUMBERS
0:                                    1:

OK
```

Figure 5.2—Sample NVRAM Settings Screen

I6 During a connection, the modem monitors and stores information about link operations. When the call is ended, you can request a diagnostic summary, as in the following example. The duration of the last call or real time is displayed depending on the K*n* setting.

```
ati6
USRobotics Courier HST Dual Standard Terbo Fax Link Diagnostics...

Chars sent              13895     Chars Received          1283
Chars lost                  0
Octets sent              5238     Octets Received          513
Blocks sent                69     Blocks Received            7
Blocks resent               0

Retrains Requested          0     Retrains Granted           0
Line Reversals              5     Blers                      0
Link Timeouts               0     Link Naks                  0

Data Compression      V42BIS 2048/32
Equalization          Long
Fallback              Disabled
Last call             00:00:00

Disconnect Reason is Keypress Abort
OK
```

Figure 5.3—Sample Link Diagnostics Screen (ATI6)

For calls under data compression, the number of characters sent may be less than the number of octets sent, due to buffering operations. Line Reversals only apply to HST-mode operations, when the modems switch the high and low speed channels. At this time, online fallback is only reported Enabled in HST-mode.

Most terms used in the display are self-explanatory except for the following:

Octets: Compressed data units. If the number of octets is greater than the number of characters sent, the modems probably used MNP5 compression on an already compressed file, and the result was expanded data.

Line Reversals: The number of times HST-mode modems switched the high and low speed channels.

Blers: Errors in data and protocol blocks. If there were many block errors, your receiver may have experienced problems on the line.

Blocks Resent: These represent blocks the remote modem resent due to the previous category, *Blers*.

Link Timeouts: Protocol detection problems: communications were severed momentarily, and the modems probably recovered. This does not indicate the retry timeout.

Link Naks: Negative acknowledgments (one or more blocks).

Data Compression: Indicates the type of data compression negotiated for the call (V42BIS or MNP5) or NONE. A V42BIS response includes the size of the dictionary and the maximum string length used, for example, 2048/32. See Appendix A for more information.

Equalization Long/Short: Status of S15 bit 0; long if bit 0=0, short if bit 0=1. Short equalization applies only to HST modems.

Fallback: Enabled/Disabled: indicates whether or not the modems negotiated online fallback during the connection sequence.

Protocol: Indicates the error control protocol negotiated (LAPM, HST, MNP, NONE) or SYNC for a synchronous call.

Speed: The last rates at which the receiver/transmitter were operating before disconnecting.

Disconnect Reason: Possible reasons the modem hung up are as follows:

> ***DTR dropped***: The computer or terminal dropped the Data Terminal Ready signal, terminating the call.
>
> ***Escape code***: The operator sent the modem the +++ escape code.
>
> ***Loss of carrier***: The modem detected loss of the remote modem's carrier and waited the duration specified in Register S10 (default is 0.7 seconds).
>
> ***Inactivity timeout***: The modem detected no activity on the line for the duration specified in Register S19 (default is 0, timer disabled).
>
> ***MNP incompatibility***: The modem is set to &M5 and the remote modem does not have MNP capability, or there was an MNP negotiation procedure error.
>
> ***Retransmit limit***: The modems reached the maximum of twelve attempts to transfer a data frame without error.

LD received: The remote modem sent an MNP error control Link Disconnect request.

DISC: The remote modem sent a V.42 Disconnect frame.

Loop loss disconnect: The modem detected a loss of current on the loop connecting it with the telephone company central office. This usually occurs because the remote modem has hung up: the central office drops current momentarily when there is a disconnect at the other end of a call. Unless Register S38 is set higher than zero, the modem immediately hangs up at loop loss.

Unable to Retrain: After several attempts, disturbances on the phone line prevented the modems from retraining, and they could no longer transmit or receive data.

Invalid speed: The modem is set to &N1 or higher, for a fixed link rate, and the remote modem is not operating at the same rate.

XID Timeout: The modems failed to negotiate the V.42 Detection (XID Exchange) phase.

SABME Timeout (Set Asynchronous Balance Mode Extended): The modems failed this part of V.42 link negotiation.

Break Timeout: Incompatible processing of a Break signal occurred.

Invalid Codeword: The modem received an invalid V.42 *bis* (compression) frame.

A Rootless Tree: The modem received an invalid V.42 *bis* (compression) frame.

Illegal Command Code: The modem received an invalid V.42 *bis* (compression) frame.

Extra Stepup: The modem received an invalid V.42 *bis* (compression) frame.

Dial Security Disconnect Reason: Possible reasons the answering modem may have hung up during a Dial Security session are as follows:

Security Abort: The modem hung up because it received an invalid password three times.

Prompting Not Enabled: The modem hung up because the originating modem did not send an autopass password, and prompting wasn't enabled.

No Prompting in Sync: The originating modem did not send an autopass password, and the answering modem cannot prompt for a password in any synchronous mode.

Non-ARQ Mode: The modem hung up because the originating modem was set for error control and the answering modem was set for non-error control.

Mode Incompatible: The modem hung up because both modems were not set to the same error control setting.

No Prompting in Non-ARQ: Prompting was enabled, but the modem hung up because the originating modem was set for error control, and the answering modem was set for non-error control. The answering modem cannot prompt when it is set for non-error control.

I7 The modem returns a product configuration. If you have a problem and call U.S. Robotics' Technical Support staff, you may be asked to read this screen.

I10 View Dial Security Account status. For security administrators only, unless local security is disabled, S53=0 or S53.2=0.

```
ati10
USRobotics Courier HST Dual Standard Terbo Fax Link Diagnostics...

                          DIAL SECURITY STATUS

    DIAL SECURITY ENABLED: [N]                LOCAL SECURITY ENABLED: [N]

    PROMPTING ENABLED: [N]                    FORCED AUTOPASS: [N]

    LOCAL ACCESS PASSWORD: [NO PSW]           AUTOPASS PASSWORD: [NO PSW]

ACCOUNT   PSW       PHONE #                        ACCT/E   DIAL/B    NEW_#
   #0     [NO PSW]                                  [N]      [N]       [N]
   #1     [NO PSW]                                  [N]      [N]       [N]
   #2     [NO PSW]                                  [N]      [N]       [N]
   #3     [NO PSW]                                  [N]      [N]       [N]
   #4     [NO PSW]                                  [N]      [N]       [N]
   #5     [NO PSW]                                  [N]      [N]       [N]
   #6     [NO PSW]                                  [N]      [N]       [N]
   #7     [NO PSW]                                  [N]      [N]       [N]
   #8     [NO PSW]                                  [N]      [N]       [N]
   #9     [NO PSW]                                  [N]      [N]       [N]
OK
```

Figure 5.4—Sample Dial Security Account Status Screen

S-REGISTER QUERY (Sr?)

This command allows you to view the contents of a particular S-Register, as in the following example that requests the contents of Register S0 ("On what ring will the modem answer?"):

ATS0? <Enter>

PHONE NUMBER QUERY (&Zn?)

At this command, the modem returns the phone number stored in NVRAM at position *n*, as in the following example that includes a sample modem response:

AT&Z3? <Enter>
5551234

LAST-DIALED NUMBER QUERY (DL?)

At this command the modem displays the number stored in the last-dialed number buffer:

ATDL?

STORED COMMAND STRING QUERY (&ZC?)

At this command the modem displays the command string stored in NVRAM with the &ZC=*s* command:

AT&ZC?

HELP SCREENS

Courier modems provide five Help screens: summaries of the basic AT command set, extended ampersand (&) command set, Dial command options, S-Register functions, and percent (%) command set.

NOTE: The Help screens are not available when the modem makes a connection in synchronous mode: &M1, &M6, or &M7.

Stop/Restart Display

The following command stops the display. Hold down the Control key and type "S":

<Ctrl>-S

To restart the display, use the same command or press any key.

Cancel Display

Either of the following commands cancels the display.

<Ctrl>-C

<Ctrl>-K

Basic Command Set ($)

At AT$, the Courier displays a screen that shows a partial summary of the command set. A second screen, activated by pressing any key, shows the remaining commands. The first screen is shown in Figure 5.5.

```
at$
HELP, Command Quick Reference <CTRL-S to Stop, CTRL-C to Cancel>

&$   HELP, Ampersand Commands       Kn    n=0  Call Duration Mode
%$   HELP, Percent Commands         n=1  Real Time Clock Mode
A/   Repeat Last Command           Mn    n=0  Speaker Off
A>   Continuously Repeat Command    n=1  Speaker On until CD
AT   Command Mode Prefix            n=2  Speaker Always On
A    Answer Call                    n=3  Speaker Off During Dial
Bn   n=0  V.32 originate mode      On    n=0  Return Online
     n=1  HST originate mode        n=1  Return Online & Retrain
Cn   n=0  Transmitter Off           n=2  Return Online & Speed Shift
     n=1  Transmitter On           P     Pulse Dial
Dn   Dial a Telephone Number       Qn    n=0  Result Codes Sent
     n=0..9#*TPR,;"W@!()-           n=1  Quiet (No Result Codes)
DL   Dial Last Phone Number         n=2  Verbose/Quiet on Answer
DSn  Dial Stored Phone Number      Sr=n  Sets Register "r" to "n"
D$   HELP, Dial Commands           Sr?   Query Register "r"
En   n=0  No Command Echo          S$    HELP, S Registers
     n=1  Echo Command Chars       T     Tone Dial
Fn   n=0  Online Echo              Vn    n=0   Numeric responses
     n=1  No Online Echo            n=1   Verbal responses
Strike any key when ready . . .
```

Figure 5.5—Sample Basic Commands HELP Screen

Extended Command Set (&$)

At AT&$, the Courier displays a screen that shows a partial summary of the extended ampersand command set. A second screen, activated by pressing any key, shows the remaining command set. The first screen is shown in Figure 5.6.

```
at&$
HELP, Ampersand Commands <CTRL-S to Stop, CTRL-C to Cancel>

&An   n=0  Disable /ARQ Result Codes   &Nn   n=0  Highest Link Speed
      n=1  Enable /ARQ Result Codes          n=1  300 bps
      n=2  Enable /Modulation Codes          n=2  1200 bps
      n=3  Enable /Extra Result Codes        n=3  2400 bps
&Bn   n=0  Floating DTE Speed                n=4  4800 bps
      n=1  Fixed DTE Speed                   n=5  7200 bps
      n=2  DTE Speed Fixed When ARQ          n=6  9600 bps
&Cn   n=0  CD Always On                      n=7  12000 bps
      n=1  Modem Controls CD                 n=8  14400 bps
&Dn   n=0  Ignore DTR                        n=9  16800 bps
      n=1  On-Line Command Mode              n=10 19200 bps
      n=2  DTE Controls DTR            &Pn   n=0  N. American Pulse Dial
&F    n=0  Load Factory Configuration        n=1  UK Pulse Dial
      n=1  Hardware Flow Control Cnfg. &Rn   n=0  CTS Follows RTS
      n=2  Software Flow Control Cnfg.       n=1  Ignore RTS
      n=3  HST/Cellular w/ HW FC Cnfg.       n=2  RX to DTE/RTS high
&Gn   n=0  No Guard Tone=w Control     &Sn   n=0  DSR Always On
      n=1  550 Hz Guard Tone                 n=1  Modem Controls DSR
      n=2  1800 Hz Guard Tone                n=2  Pulse DSR, CTS=CD
Strike a key when ready. . .
```

Figure 5.6—Sample Ampersand Commands HELP Screen

Dialing (D$)

At ATD$, the Courier displays this Dial command summary:

```
atd$
HELP, Dial Commands <CTRL-S to Stop, CTRL-C to Cancel>

0-9 Digits to Dial
*   Auxiliary Tone Dial Digit
#   Auxiliary Tone Dial Digit
T   Tone Dialing
P   Pulse Dialing
R   Call an Originate Only Modem
,   Pause (Wait for S8 Time)
;   Remain in Command Mode After Dialing
''  Used to Dial Alpha Phone #'s
W   Wait for 2nd Dial Tone (X3-X7)
@   Wait for an Answer (X3-X7)
!   Flash Switch Hook

OK
```

Figure 5.7—Sample Dial Command HELP Screen

S-Register Functions (S$)

At ATS$, the Courier displays a screen that shows a partial summary of the S-Register functions. A second screen, activated by pressing any key, shows the remaining registers. The first screen is as follows.

```
HELP, S Register Functions <CTRL-S to Stop, CTRL-C to Cancel>

S0  Ring to Answer On                 S19 Inactivity Timeout (min)
S1  Counts # of Rings                 S20 Reserved
S2  Escape Code Char                  S21 Break Length (1/100sec)
S3  Carriage Return Char              S22 Xon Char
S4  Line Feed Char                    S23 Xoff Char
S5  Backspace Char                    S24 DSR Pulse Time (1/50sec)
S6  Wait Time/Dial Tone (sec)         S25 Reserved
S7  Wait Time/Carrier (sec)           S26 RTS/CTS Delay Time (1/100sec)
S8  Comma Time (sec)                  S27 Bit Mapped
S9  Carrier Detect Time (1/10sec)           1 = V21 Mode
S10 Carrier Loss Time (1/10sec)             2 = Disable TCM
S11 Dial Tone Spacing (msec)                4 = Disable V32
S12 Escape Code Time (1/50sec)              8 = Disable Z100hz
S13 Bit Mapped                             16 = Disable MNP Handshake
      1 = Reset On DTR Loss                32 = Disable V.42 Detect Phase
      2 = Do Originate in Auto Answer      64 = Reserved
      4 = No Pause Before Result Codes    128 = Unusual SW-Incompatibility
      8 = Do DS0 On DTR               S28 V32 Handshake Time (1/10sec)

Strike a key when ready . . .
```

Figure 5.8—Sample S-Register HELP Screen

Percent Commands (%$)

At AT%$, the Courier displays a screen that shows a partial summary of the percent command functions. A second screen, activated by pressing any key, shows the remaining registers. The first screen is as follows.

```
at%$
HELP, Command Quick Reference <CTRL-S to Stop, CTRL-C to Cancel>

%An= Security Account Information   %Fn   Remote DTE Format
       command structure                    n=0  8, No parity
%An=PW,ACCT E,DIAL 8,NEW #,PH#              n=1  7, Mark parity
     n = 0-9                                n=2  7, Odd parity
     PW = Password                          n=3  7, Even parity
     ACCT E = Account Enable          %L=PWn Security Local Access Psw
     DIAL B = Dial Back Enable              PWn = (0-9)
     NEW # = New Dial Back #          %Mn   V.25 bis Synchronous Clock Rate
     PH# = Dial Back Phone                  n=0  RESERVED
%Bn  Remote DTE Data Rate                   n=1  RESERVED
     n=0    110 bps                         n=2  1200 bps
     n=1    300 bps                         n=3  2400 bps
     n=2   1200 bps                         n=4  4800 bps
     n=3   2400 bps                         n=5  7200 bps
     n=4   4800 bps                         n=6  9600 bps
     n=5   7200 bps                         n=7  12000 bps
     n=6   9600 bps                         n=8  14400 bps
     n=7  19200 bps                         n=9  16800 bps
     n=8  38400 bps                         n=10 19200 bps
Strike any key when ready . . .
```

Figure 5.9—Sample Percent HELP Screen

TABLE OF CONTENTS

PART II. REFERENCE

continued

APPENDIX A. LINK NEGOTIATION (HANDSHAKING) AND ERROR CONTROL

This appendix includes detailed information on how U.S. Robotics modems in HST and V.32 *terbo* mode negotiate with remote modems for the rate and other characteristics of each connection. You may find it helpful if you are having difficulty connecting with another modem.

In addition, you'll find information on error control and, especially useful, some statistics and guidelines on using the modem for the best throughput.

The following text relies on familiarity with the term *ARQ*. ARQ (automatic repeat request) designates a connection under error control.

LINK NEGOTIATION (HANDSHAKING)

During high-speed link negotiation, timing and procedures differ for HST or V.32 *terbo* modulation, as follows.

HST-mode

Serial port rate: 115.2K/57.6K/38.4K/19.2K/9600 bps (115.2K, 57.6K, or 38.4K required for 16.8K or 115.2K, 57.6K, 38.4K, or 19.2K for 14.4K connections)
Modem settings: B1, &B1, &H1/&H2/&H3, &M4/&M5, &N0

1. The modems begin handshaking by training (synchronizing) at 2400 bps and exchanging information on their error control, data compression, and speed capabilities.
2. Once the modems enable error control, handshaking proceeds as follows. If the remote modem is operating at 2400 bps or lower, the Courier stays at 2400 bps or falls back to match the remote modem's slower rate.

   If the remote modem is HST-compatible and operating at a higher speed, both modems shift up and train at 9600 bps. From there, depending on the speed of the remote modem,

they shift up again to 12K bps, 14.4K bps, and again to 16.8K bps; or they fall back to 7200 bps and again to 4800 bps, if the remote modem is operating at one of those lower speeds.

Initially, the high-speed channel is allocated to the answering modem, the 450-bps channel to the calling modem. This allocation reverses if the calling modem has more data to transmit than the answering modem.

Specialized High-Speed Connection

It's possible for two modems in HST-mode to connect directly at 9600, 12K, 14.4K or 16.8K bps, without 2400 bps handshaking. However, this is only recommended for faster connections in specialized installations where the computer and software manage error control. The reason is that there can be no error control because HST modems negotiate error control during 2400 bps handshaking.

Both modems must be set as follows. High speed handshaking requires a fixed connection rate: the modem only connects if the remote modem is operating at the same connection rate—9600 (&N6), 12K (&N7), 14.4K bps (&N8), or 16.8K bps (&N9).

Serial port rate: 115.2K/57.6K/38.4K/19.2K/9600 bps (57.6K, 38.4K, or 19.2K required for 16.8K or 14.4K connections)
Modem settings: B1, &B1, &H1/&H2/&H3, &M0, &N6/&N7/&N8/&N9

HST-mode, Error Control Disabled

If error control is disabled—that is, the Courier HST is set to &M0 or the remote modem isn't set for error control and the Courier HST reverts to &M0—the Courier operates in one of the following ways.

1. If set to &N0, it only connects at 2400 bps or lower. This ensures that there will not be data transfer at high speeds unless the call is protected by error control.

   Courier HST modems negotiate error control during 2400 bps handshaking. If they cannot connect under error control, they stay at 2400 bps. Or, if the remote modem is operating at a lower rate, the Courier HST switches to the lower rate.

2. If set to &N6, &N7, &N8 or &N9, the Courier will handshake at the higher speed, 9600, 12K, 14.4K or 16.8K bps, as shown in the previous configuration example, *Specialized High-Speed Connection*. However, that configuration example should only be used in the special situation described, where the system takes care of error control.

NOTE: Without error control, there are no high speed line reversals. The high speed channel is always allocated to the answering modem. Also, there is no online fallback to protect the connection on impaired lines.

V.32 terbo Mode

The V.32 *terbo* handshaking described in this section is proprietary to U.S. Robotics, and allows two V.32 *terbo* modems to connect at 21.6K and 19.2K bps. In addition, U.S. Robotics V.32 *terbo* modems, *when connecting with each other*, use an enhanced proprietary handshaking procedure which allows them to connect faster and to retrain faster during calls. They must, however, establish a V.42 error control connection. This proprietary handshaking is described after the next section, under *U.S. Robotics V.32 terbo to U.S. Robotics V.32 terbo*.

V.32 terbo

NOTE: High speed calls are highly vulnerable to errors unless the data is protected by error control. The operations described below take place even if one of the modems is not set for error control, thereby prohibiting error control for the call.

Serial port rate: 115.2K/57.6K/38.4K/19.2K bps
Modem settings: B0, &B1, &H1/&H2/&H3, &M4/&M5, &N0

WARNING: If the calling modem dials in at 19.2K, 16.8K, 14.4K or 12K bps (for 19.2K, 16.8K, or 14.4K bps connections), answering V.32 *terbo* modems shift their serial port rate up to 19.2K bps, and send information to the computer at 19.2K bps. If your computer is limited to a rate of 9600 bps, disable high-speed modulation by setting Register S34 to a value of 3 (ATS34=3). The calling modem will then shift down to 9600 bps for a V.32, not V.32 *terbo*, connection.

1. The answering modem first sends out a 2100 Hz answer tone identifying it as a V.32 or V.32 *terbo* modem. If the calling modem recognizes the tone, the modems connect at the highest possible speed, 19.2K or 16.8K bps. If the calling modem is a V.32 modem, its maximum speed is 9600 bps, and the modems may connect at that rate. But see paragraph 3.
2. If the calling modem doesn't recognize the answer tone, the answering modem then sends a 2250 Hz answer tone used by 2400, 1200 or 300 bps modems. If the calling modem is operating at one of those rates, the modems connect at the calling modem's rate.
3. If the modems don't connect as in paragraph 1 or 2, the answering V.32 *terbo* modem then sends extra V.32 answer tones. If the calling modem is a V.32 modem, the answering V.32 *terbo* modem shifts its speed down to 9600 bps and the modems connect at that speed. This extended V.32 handshaking ensures connections with V.32 modems if they did not connect as in paragraph 1.

   It may even be necessary to extend the length of these tones if the modem is to answer older, "dumb" V.32 modems. Register S28 is used to modify the duration of these extra V.32 tones. See S28 in Appendix B.

U.S. Robotics V.32 terbo to U.S. Robotics V.32 terbo

1. The modems first negotiate a V.42 error control connection. Speed negotiation is part of the V.42 detection/LAPM sequence. If they fail to make a V.42 connection, these modems follow the procedures described under *V.32 terbo*, above.
2. The Receiver of each modem dictates its modem's highest speed, with negotiation beginning at 7200 bps and proceeding upward to the 21.6K bps maximum. This means that your modem's receiver may be operating at a different speed from your modem's transmitter, which operates at the same rate as the remote modem's receiver. In other words, the rate at your modem's Originate frequency may be different from the rate at your modem's Answer frequency.

   Because of this asymmetrical design, one frequency may suffer line hits or other impairments, and fall back to a

slower speed, while the other does not. The result is more efficient line operation. If the impairments are severe, the modems use normal retraining.

NOTE: Answering V.32 *terbo* modems shift their serial port rate up to 38.4K (for 21.6K connections) if the calling V.32 *terbo* modem dials in at 21.6K. The answering V.32 *terbo* modem then sends data to its computer at 38.4K bps.

Dual Standard Handshaking

Dual Standard modems always connect with each other, either in HST-mode or in V.32 *terbo* mode. However, we recommend that Dual Standard modems be set to B0 and to &N0, so that they can connect with V.32 *terbo*, HST and lower-speed modems, in both Originate and Answer modes.

A Dual Standard modem set to B1 (HST) does not send out any V.32 *terbo* or V.32 answer tones, and therefore cannot answer calls in those modes. A Dual Standard modem set to B0 will switch to HST-mode for that call only if the other modem is operating in HST-mode.

ERROR CONTROL AND THROUGHPUT

Overview

Error control is available for calls at 1200 bps and above. It can be disabled, although high speed calls (above 2400 bps) should always be under error control. The operations defined in an error control protocol include the following:

- Establishment of compatibility
- Data frame formatting
- Error detection through Cyclic Redundancy Checking (CRC)
- Retransmission of corrupt data frames

The Courier is set at the factory to &M4, causing it to try for an error control connection and, if that isn't possible, to proceed with the call in Normal mode. The modem first tries for a V.42 connection, then an MNP connection. The following information is based on the Courier's setting of &M4.

V.42 Handshaking

This international standard includes a two-stage handshaking process:

- A Detection phase that is based on an exchange of predefined characters.
- LAPM (Link Access Procedures for Modems) Negotiation. In this phase, the modems identify their capabilities concerning maximum data block size and the number of outstanding data blocks allowed before an acknowledgment is required.

MNP Handshaking

This protocol is supported by the ITU-T V.42 Recommendation. It was originally developed by Microcom, Inc. and is now in the public domain.

MNP is based on special protocol frames. If the remote modem doesn't recognize an MNP Link Request, error control isn't possible. (In HST asymmetrical mode, U.S. Robotics modems use a proprietary scheme similar to MNP.)

Data Compression

If the modems successfully establish a V.42 connection, they also negotiate for V.42 *bis* data compression. If they successfully establish an MNP connection, they negotiate for MNP5 data compression. The type of compression for a call, if any, is reported in the ATI6 display, and in the CONNECT message if the modem is set to &A3.

Modems using V.42 *bis* compression negotiate the following options and report them in the ATI6 display.

- Dictionary size, that is, the amount of memory available for compression table entries. (Entries are codes devised for redundant data. The data is packed into shorter data units, called code words, and unpacked by the receiving modem.)

  Possible sizes are as follows. U.S. Robotics modems use 11-bit, or 2048-entry dictionaries, but drop down if the remote modem uses a 512- or 1024-entry

dictionary. The size of the dictionary for a call is reported in the ATI6 display.

Bits	Entries
9	512
10	1024
11	2048

- Maximum string length of each entry. As the dictionary fills, the modem deletes the oldest unused strings.

V.42 *bis* compression is more efficient than MNP5 compression in part because it dynamically deletes entries that are no longer used. In addition, it works better with files that are already compressed. These include .ZIP files downloaded from many Bulletin Boards and 8-bit binary files, which seem to the modem to be compressed.

MNP5 compression should not be used with such files because it adds data to them, which lessens throughput. (The additional data is stripped when the file is decompressed by the remote modem.) When transferring such files, it's best to set the modem to &K3: this allows V.42 *bis* compression to work dynamically with the compressed data, but disables MNP5.

Flow Control

Flow control of data from the computer is required under error control for two reasons:

1. The transmitting modem buffers a copy of each frame it transmits to the remote end until it is acknowledged by the receiving modem.
2. If errors are encountered, retransmission activity can cause a steady stream of data from the computer to overflow the buffer.

Throughput Guidelines

The following guidelines should help to make the most of the modem's advanced performance features. In many instances, experimentation and experience will indicate what works best for your applications.

1. Optimal throughput is attained under the following conditions:

- The communications software allows fixing the serial port rate higher than the connection rate, by setting the software to 115.2K, 57.6K, or 38.4K bps and setting the modem to &B1.

  If the software automatically switches serial port rates to follow the connection rate, the modem's serial port rate must be also set to follow the connection rate for each call, &B0, and throughput will be limited.

  Installations with specialized software may want to enable a fixed serial port rate for ARQ calls and a variable serial port rate for non-ARQ calls. See the &B2 command in Chapter 3.

- The call is under data compression.
- The data is comprised of text files rather than binary files such as .EXE or .COM files. See the table at the end of this appendix.

2. MNP5 compression is disabled for files that are already compressed and 8-bit binary files, that appear to the modem to be already compressed. MNP5 is disabled by setting the modem to &K3.

3. The file transfer is not slowed down by a file-transfer protocol. Many non-text files require a file transfer protocol, but the results vary. For example, certain public domain file transfer protocols have the following effects:

Kermit	Newer versions support packets up to 9K and a sliding window design to eliminate turn-around delay. With earlier versions, however, throughput may be severely reduced due to short block lengths (possibly under 128 bytes) and acknowledgment turnaround time.
Xmodem	Throughput may be reduced if your version uses short block lengths (128 bytes). Some versions use larger blocks (1K blocks). Throughput is also reduced by overhead (error control protocol information).

Ymodem — There is an improvement over Xmodem, due to larger block lengths (1K bytes), but throughput is still reduced by the protocol's error control overhead.

The above protocols further reduce throughput when an error control connection is established. The accuracy of the data is checked both by the file transfer protocol and the modem. To avoid redundancy, use the above protocols only for non-ARQ connections, and only at speeds of 2400 bps and below.

For the best throughput, but on error-controlled connections only and with hardware flow control, we recommend the most current version of Zmodem. Overhead is minimal with this protocol, with throughput almost equal to that obtained with no file-transfer protocol. Zmodem should also be used for non-ARQ connections. Leave the modem at its &M4 and &K1 settings for both error control and data compression. Ymodem-G is another good choice, but never without both the local and remote modems using error control: if Ymodem-G detects an error, it aborts the transfer. Do not use either protocol with software flow control (XON/XOFF signaling).

Achievable Throughput

The table on the next page indicates the maximum throughput, in characters per second (cps), that can normally be expected under the following conditions.

- Connection (link) rate of 14.4K bps
- Serial port rate set at 57.6K bps; modem set to &B1
- V.42 *bis* compression negotiated for the call, and the default size 11-bit, 2048-entry dictionary
- Straight data (not already compressed, no file-transfer protocol)
- Transmission from a fast (486) computer

File Type	Throughput (cps) when set to 14.4K bps MNP5	V.42 *bis*
Assembler or Compiler listing	2880	3840
Text file	2325-2625	3400-5760
Binary file: .EXE	2175-2400	2030-2600
Binary file: .COM	2100-2250	2050-2300
.ZIP files (common on BBS's)*	1500-1650	1700
Random binary 8-bit*	1460-1575	1700

* These files are already compressed or appear to the modem to be compressed. Additional MNP5 compression causes throughput lower than what can be expected using MNP without compression. We recommend setting the modem to &K3 when transferring these files, to allow V.42 *bis* but disable MNP5.

The following table indicates the maximum throughput, in characters per second (cps), that can normally be expected under the same conditions as the previous table, but with a connection rate of 16.8K bps.

File Type	Throughput (cps) when set to 16.8K bps MNP5	V.42 *bis*
Assembler or Compiler listing	3360	4480-5760
Text file	2713-3063	3967-5760
Binary file: .EXE	2538-2800	2368-3033
Binary file: .COM	2450-2625	2392-2683
.ZIP files (common on BBS's)*	1750-1925	1983
Random binary 8-bit*	1703-1838	1983

* We recommend setting the modem to &K3 when transferring these types of files. See the note attached to the previous table.

APPENDIX B. SUMMARIES AND TABLES

CONTENTS

THE RS-232 INTERFACE

DESCRIPTION

The RS-232 interface is a standard developed by the Electronic Industries Association (EIA). It defines the signals and voltages used when data is exchanged between a computer or terminal and a modem or serial printer. Data is transmitted between the devices via a cable with 25-pin, 9-pin, 8-pin or custom-built connectors.

PIN ASSIGNMENTS

The entire standard covers many more functions than are used in most data communications applications. Pin assignments are factory set in the Courier to match the standard DB-25 assignments in the following table. DB-9 connectors for AT-compatible computers should be wired at the computer end of the cable as shown in the DB-9 column. If you're using an Apple computer, we strongly recommend that you purchase a *Hardware Handshaking* cable to get the highest possible reliability performance.

DB-25	DB-9	Circuit	Function	Signal Flow Computer—Modem
1	—	AA	Chassis Ground	both directions
2	3	BA	Transmitted Data	to modem
3	2	BB	Received Data	to computer
4	7	CA	Request to Send	to modem
5	8	CB	Clear to Send	to computer
6	6	CC	Data Set Ready	to computer
7	5	AB	Signal Ground	both directions
8	1	CF	Carrier Detect	to computer
12	—	SCF	Speed Indicate	to computer
15	—	DB	Synchronous TX* Timing	to computer
17	—	DD	Synchronous RX* Timing	to computer
20	4	CD	Data Terminal Ready	to modem
22	9	CE	Ring Indicate	to computer
24	—	DA	Synchronous TX* Timing	to modem

* Indicates Transmitter (TX) or Receiver (RX)

Table B.1—RS-232 Interface Pin Definitions

Minimum Requirements

Some computer/terminal equipment supports only a few of the RS-232 signal functions set in the Courier. The minimum required for the modem to operate are as follows:

Asynchronous Calls

DB-25 Pin	DB-9 Pin	Function
2	3	Transmitted Data
3	2	Received Data
7	5	Signal Ground
20	4	Data Terminal Ready*

* Required only if you have the Data Terminal Ready Operations switch OFF (DIP switch 1 OFF).

Synchronous Calls

You will need all of the above functions as well as pin 15 for Transmitter timing signals, and pin 17 for Receiver timing signals. You may need pin 24, which is assigned the external timing source, rather than the internal (modem) source assigned to pin 15. See Appendix E for more detailed information.

Additional Flow Control Functions

If your computer and software support Clear to Send and you wish to use Transmit Data hardware flow control (&H1), Pin 5 (DB-25) or Pin 8 (DB-9) is required.

If your computer and software support Request to Send and you wish to use Received Data hardware flow control (&R2), Pin 4 (DB-25) or Pin 7 (DB-9) is required.

FOR 38.4K SERIAL PORT RATE OR HIGHER

Your terminal or computer and software must support the 115.2K, 57.6K, or 38.4K bps rate. Make sure the RS-232 cable is shielded. Cables are normally six feet long, but longer lengths are possible. If you encounter problems with signal degradation, try a shorter cable.

If you decide to build your own cable, use a low-capacitance cable. To further minimize the capacitance, connect only those functions (pins) that your application requires.

FRONT PANEL INDICATORS

Symbol	Meaning	Status
HS	High Speed	All calls above 2400 bps: ON during call progress, after completion of dialing; OFF during HST-mode link negotiations at 2400 bps, then ON during connection. Remains ON after disconnect until next call is originated or answered, or the modem is reset.
AA	Auto Answer/ Answer	Answer mode only: ON when your modem is in Auto Answer mode, and when answering a call; in HST-mode, goes OFF if the channel is reversed and your answering modem transmits at 450 or 300 bps. Also goes OFF when the modem originates a call. Flashes ON for incoming ring detect.
CD	Carrier Detect	ON if DIP switch 6 is OFF (factory setting) and the Courier receives a valid data signal (carrier) from a remote modem, indicating that data transmission is possible. Also ON when the CD override is on, DIP switch 6 ON.
OH	Off Hook	ON when the Courier takes control of the phone line to establish a data link.
RD	Received Data	Flashes when the modem sends result codes or passes received data bits to the computer or terminal.
SD	Send Data	Flashes when the computer or terminal sends a data bit to the Courier.
TR	Data Terminal Ready	ON if DIP switch 1 is OFF (factory setting) and the modem receives a DTR signal from the computer or terminal. Also ON when the DTR override is on, DIP switch 1 ON.
MR	Modem Ready/ Test Mode	ON when the Courier is powered on. Flashes when the modems retrain, including online fallback, or while the modem is in Test mode.

Symbol	Meaning	Status
RS	Request to Send	ON if your terminal or software supports RTS and sends the RTS signal. OFF if the Courier is set to &R2 (Received Data hardware flow control) and the computer or terminal lowers RTS.
CS	Clear to Send	ON until the modem lowers CTS when Transmit Data hardware flow control is enabled (&H1, &H3). Always ON during synchronous connections.
SYN	Synchronous Mode	ON when the modem is set to &M1, &M6, &M7 and enters synchronous mode.
ARQ/ FAX	Error Control/ Fax Operations	Data Mode: Automatic Repeat Request. ON when the Courier is set to &M4 or &M5 and successfully connects with another modem under error control. Flashes randomly when the Courier retransmits data to the remote modem. Fax Mode: Flashes steadily to indicate fax mode.

DIP SWITCH SUMMARY

PURPOSE

The DIP switches, located at the rear of the modem, are for adapting the modem to your equipment and personal requirements. The quick-configuration guide that comes with the modem indicates the recommended switch settings for many communications software packages. If necessary, review your software documentation.

Some users are able to move a single switch with a finger tip. If this doesn't work for you, use a toothpick or other small instrument. Do not use a lead pencil.

OPERATIONS

The DIP switch settings are power-on defaults, read by the Courier when it is turned on. If changed when the modem is on, switches 1-7, and 9 require the ATZ (software reset) command to initiate the new settings. If you've set switch 8 OFF to disable command recognition, and want to return the modem to Smart mode so that it responds to commands, you'll have to power off the modem, reset switch 8 ON, and power on the modem again.

When you issue the ATZ command, the modem reads its DIP switch settings and resets either to its defaults (DIP switch 10 OFF) or factory settings (DIP switch 10 ON).

Switch	Factory Setting	Function
1	OFF	Data Terminal Ready Operations OFF Normal DTR operations: computer must provide DTR signal for modem to accept commands; dropping DTR terminates a call ON DTR always ON (Override)

continued

Switch	Factory Setting	Function
2	OFF	Verbal/Numeric Result Codes OFF Verbal (word) results ON Numeric results
3	ON	Result Code Display OFF Results suppressed ON Results enabled
4	OFF	Command Mode Local Echo OFF Keyboard commands displayed ON Echo suppressed
5	ON	Auto Answer OFF Modem answers on first ring ON Auto answer disabled
6	OFF	Carrier Detect Operations OFF Courier sends CD signal when it connects with another modem, drops CD on disconnect ON CD always ON (Override)
7	OFF	Auxiliary, DIP Switch 3 ON OFF Result codes in Originate and Answer mode ON Result codes in Answer mode disabled
8	ON	AT Command Set Recognition OFF Command recognition disabled (Dumb mode) ON Recognition enabled (Smart mode)
9	OFF	Escape Code (+++) Response OFF Modem hangs up, returns to Command mode, sends NO CARRIER result ON Modem maintains connection, returns to Command mode, sends OK result

continued

Switch	Factory Setting	Function
10	OFF	Power-on and ATZ Reset Software Defaults OFF Load from nonvolatile memory (NVRAM) ON Load factory settings from read only memory (ROM)
QUAD SWITCH	OFF	RS-232 Transmit/Receive Pin Assignments OFF Normal assignments; see *Pin Assignments* earlier in this appendix ON Reversed Transmit/Receive pins *The need to change this switch setting is rare.* Carefully review your computer or terminal documentation before setting this switch ON.

USER-PROGRAMMABLE DEFAULTS

You can create your own default configuration and store it in nonvolatile random access memory (NVRAM) using the &W command described in Chapter 3. As long as DIP switch 10 is OFF when you power on the modem, your defaults are loaded into the modem's random access memory (RAM). To view your NVRAM settings at any time, use the ATI5 command.

Tables on the next several pages list the options you can store in NVRAM, including S-Register settings. If DIP switch 10 is ON at power-on, the factory template 0 settings are loaded instead. The modem has four factory setting templates (&F0–F3). By default, the first time the modem is turned on, the modem loads the settings stored in NVRAM, which are the same as the settings in factory template 1 (&F1).

The following command example substitutes several user-defined defaults for factory settings. The modem also stores the rate, word length and parity it detects from the AT command prefix.

AT X1 &B0 &M5 &H0 M3 &W <Enter>

The modem is shipped with DIP switch 10 OFF, so when it is powered on it loads the settings from NVRAM. Until these settings are changed, they are they same as the settings permanently stored in factory settings template 1 (&F1). You can alter any of these settings, create your own power-on defaults, and then save them with the &W command. See Chapter 3.

Table B.3—&F1 Hardware Flow Control Default Template

NVRAM Options	Setting	Description
Handshake option	B0	ITU-T answer sequence
Error control/sync	&M4	Normal/error control
Data compression	&K1	Enabled
Transmit data hardware	&H1	Hardware flow control
Rec'd data hardware flow control	&R2	Enabled
Rec'd data software flow control	&I0	Disabled
Serial port rate select	&B1	Serial port rate fixed higher than connect rate
Link rate select	&N0	Variable
Result code subset	X7	Extended. Includes all codes except VOICE
Protocol response codes	&A3	Full protocol codes
Tone/Pulse dialing	P	Pulse dial
Online local echo	F1	Disabled
Speaker control	M1	ON during dial through connect
Remote Digital Loopback (RDL)	&T5	Deny RDL
Normal/Leased/Cellular line	&L0	Normal phone line
Data Set Ready operations	&S0	Override enabled
Break handling	&Y1	Clear buffer, send immediately
Stored telephone number	&Z0–9=0	Blank
Pulse dial make/break ratio	&P0	U.S./Canada
Guard tone	&G0	U.S./Canada
Rack Controller Unit (RCU) Access	%R0	RCU access disabled
Word length*	8	
Parity*	0	None
DTE rate* (Kbps)	19.2	—

* Detected by the modem from the AT prefix of the &W command that writes your defaults to NVRAM. Set your software to the desired word length, parity, and serial port rate defaults before sending the modem the AT . . . &W string.

The &F2 and &F3 factory setting templates are similar to the &F1, with the exception of the commands which are highlighted in bold in tables B.4 and B.5.

Table B.4—&F2 Software Flow Control Template

NVRAM Options	Setting	Description
Handshake option	B0	ITU-T answer sequence
Normal/error control/sync	&M4	Normal/error control
Data compression	&K1	Enabled
Transmit data flow control	**&H2**	**Software flow control**
Rec'd data hardware flow control	**&R1**	**Disabled**
Rec'd data software flow control	**&I2**	**Enabled**
Serial port rate select	&B1	Serial port rate fixed higher than connect rate
Link rate select	&N0	Variable
Result code subset	X7	Extended. Includes all codes except VOICE
Protocol response codes	&A3	Full protocol codes
Tone/Pulse dialing	P	Pulse dial
Online local echo	F1	Disabled
Speaker control	M1	ON during dial through connect
Remote Digital Loopback (RDL)	&T5	Deny RDL
Normal/Leased/Cellular line	&L0	Normal phone line
Data Set Ready operations	&S0	Override enabled
Break handling	&Y1	Clear buffer, send immediately
Stored telephone number	&Z0–9=0	Blank
Pulse dial make/break ratio	&P0	U.S./Canada
Guard tone	&G0	U.S./Canada
Rack Controller Unit (RCU) Access	%R0	RCU access disabled
Word length*	8	
Parity*	0	None
DTE rate* (Kbps)	19.2	—

* Detected by the modem from the AT prefix of the &W command that writes your defaults to NVRAM. Set your software to the desired word length, parity, and serial port rate defaults before sending the modem the AT . . . &W string.

Table B.5—&F3 HST Cellular Template

NVRAM Options	Setting	Description
Handshake option	**B1**	**HST-mode/Bell answer tone**
Normal/error control/sync	&M4	Normal/error control
Data compression	&K1	Enabled
Transmit data flow control	&H1	Hardware flow control
Rec'd data hardware flow control	&R2	Enabled
Rec'd data software flow control	&I0	Disabled
Serial port rate select	&B1	Serial port rate fixed higher than connect rate
Link rate select	&N0	Variable
Result code subset	X7	Extended. Includes all codes except VOICE.
Protocol response codes	&A3	Full protocol codes
Tone/Pulse dialing	P	Pulse dial
Online local echo	F1	Disabled
Speaker control	M1	ON during dial through connect
Remote Digital Loopback (RDL)	&T5	Deny RDL
Normal/Leased/Cellular line	**&L2**	**HST Cellular**
Carrier loss wait time	**S10=30**	**Tenths of seconds**
Data Set Ready override	&S0	Enabled
Break handling	&Y1	Clear buffer, send immediately
Stored telephone number	&Z0–9=0	Blank
Pulse dial make/break ratio	&P0	U.S./Canada
Guard tone	&G0	U.S./Canada
Rack Controller Unit (RCU) Access	%R0	RCU access disabled
Word length*	8	
Parity*	0	None
DTE rate* (Kbps)	19.2	—

* Detected by the modem from the AT prefix of the &W command that writes your defaults to NVRAM. Set your software to the desired word length, parity, and serial port rate defaults before sending the modem the AT . . . &W string.

If DIP switch 10 is ON when the modem is powered on, or you load factory template 0 (&F0), the following settings take effect. The differences between factory template 0 (&F0) and factory template 1 (&F1) are noted in bold.

Table B.6—&F0 No Flow Control Template

NVRAM Options	Setting	Description
Handshake option	B0	ITU-T answer sequence
Normal/error control/sync	&M4	Normal/error control
Data compression	&K1	Enabled
Transmit data flow control	**&H0**	**Disabled**
Rec'd data hardware flow control	**&R1**	**Disabled**
Rec'd data software flow control	&I0	Disabled
Serial port rate select	**&B0**	**Detect from AT command: variable rate**
Link rate select	&N0	Variable
Result code subset	**X1**	**Basic**
Error-control response codes	**&A1**	**Enabled**
Tone/Pulse dialing	P	Pulse dial
Online local echo	F1	Disabled
Speaker control	M1	ON during dial through connect
Remote Digital Loopback (RDL)	&T5	Deny RDL
Normal/Leased/Cellular line	&L0	Normal phone line
Data Set Ready operations	&S0	Override enabled
Break handling	&Y1	Clear buffer, send immediately
Stored telephone number	&Z0–9=0	Blank
Pulse dial make/break ratio	&P0	U.S./Canada
Guard tone	&G0	U.S./Canada
Rack Controller Unit (RCU) Access	%R0	RCU access disabled
Word length*	**7**	
Parity*	**1**	**Even**
DTE rate* (bps)	**9600**	**—**

* Detected by the modem from the AT prefix of the &W command that writes your defaults to NVRAM. Set your software to the desired word length, parity, and serial port rate defaults before sending the modem the AT . . . &W string.

NVRAM S-Register Options		Factory Setting
S0	Auto Answer	1
S2	Escape code character	43
S3	Carriage Return character	13
S4	Line Feed character	10
S5	Backspace character	8
S6	Dial wait-time, sec.	2
S7	Carrier wait-time, sec.	60
S8	Dial pause, sec.	2
S9	Carrier Detect time, 1/10th sec.	6
S10	Carrier loss wait-time, 1/10th sec.	7
S11	Tone duration, spacing, msec.	55
S12	Escape code guard time, 1/50th sec.	50
S13	Bit-mapped functions	0
S15	Bit-mapped functions	0
S19	Inactivity/hang up timer	0
S21	Break length, 1/100th msec.	10
S22	XON character	17
S23	XOFF character	19
S24	Pulsed DSR duration, 2/100th sec.	150
S26	RTS/CTS delay time, 1/100th sec.	1
S27	Bit-mapped functions	0
S28	V.32 handshake time, 1/10th sec.	8
S29	V.21 handshake time, 1/10th sec.	20
S32	Talk/Data Switch Options	9
S33	Bit-mapped functions	0
S34	Bit-mapped functions	0
S38	Disconnect wait time, sec.	0
S41	Allowable remote login attempts	0
S42	Remote Access ASCII character	126
S43	Remote guard time, 1/50th sec.	200
S44	Re-establish leased-line connect, sec.	15
S51	Bit-mapped functions	0
S53	Bit-mapped functions	0

* Bit-mapped registers have up to eight functions. See descriptions later in this appendix or a briefer summary in the Quick Reference Card.

S-REGISTER SUMMARY

USAGE

The default values are those users typically require. Change the settings of an S-Register with the ATS*r*=*n* command, where *r* is the register and *n* is a decimal value from 0-255:

ATS13=8 <Enter>

The modem does not perform a value-range check. Some values you select may not work with some equipment, and you'll have to readjust the settings.

Some registers (S13, S14, S15, S16, S27, S34) are bit-mapped (bits 0-7). For example, turning on bit 0 of S13 causes the modem to reset each time the computer or terminal drops its Data Terminal Ready (DTR) signal. Turning on bit 3 of S13 causes the modem, on receipt of DTR, to auto dial the number stored at position 0 in NVRAM.

To turn on one or more bits in any bit-mapped register, use the total of the values shown below. For example, S13=9 turns on bits 0 (value of 1) and 3 (value of 8).

Alternatively, identify the bits to be turned on with the following format: S*r*.*b*=1, where *r* is the register and .*b* is the bit. This format does not require knowledge of the bit's value. S13.0=1 .3=1 is the equivalent of S13=9, above. To turn off a bit function, set it to zero: S13.0=0.

To display the contents of a register, use ATS*r*? as in this example:

ATS1?

To display the contents of a register, use ATS*r*? as in this example:

ATS19? <Enter>

Register	Default	Function
S0	See DIP Switch 5	Sets the number of rings on which to answer when in Auto Answer mode. S0=0 disables Auto Answer, the same as DIP switch 5 ON (factory setting). S0=1 enables Auto Answer and the modem answers on the first ring. **NOTE:** If DIP switch 5 is OFF and S0=0, Auto Answer remains disabled.
S1	0	Counts and stores the number of rings from an incoming call.
S2	43	Stores the ASCII decimal code for the escape code character. Default character is "+". A value of 128-255 disables the escape code.
S3	13	Stores the ASCII decimal code for the Carriage Return character.
S4	10	Stores the ASCII decimal code for the Line Feed character.
S5	8	Stores the ASCII decimal code for the Backspace character. A value of 128-255 disables the Backspace key's delete function.
S6	2	Sets the number of seconds the modem waits before dialing. If set to X2, X4, X6, or X7, the modem dials as soon as it detects a dial tone (fast dials). If there is no dial tone, the modem observes the normal S6 timeout. **NOTE:** The modem cannot be set for a value lower than 2.
S7	60	Sets the number of seconds the modem waits for a carrier. May be set for much longer duration if, for example, the modem is originating an international connection.

Register	Default	Function
S8	2	Sets the duration, in seconds, for the pause (,) option in the Dial command and the pause between command re-executions (> and A> commands).
S9	6	Sets the required duration, in tenths of a second, of the remote modem's carrier signal before recognition by the Courier.
S10	7	Sets the duration, in tenths of a second, that the modem waits after loss of carrier before hanging up. This guard time allows the modem to distinguish between a line hit, or other disturbance that momentarily breaks the connection, from a true disconnect (hanging up) by the remote modem. While we do not recommend connecting the modem to a line with call waiting, if you have call waiting you may wish to adjust this setting upward to prevent the modem from misinterpreting the signal for a second call as a disconnect by the remote modem. A better alternative is to contact your phone company to find out how to temporarily disable call waiting.
S11	70	Sets the duration and spacing, in milliseconds, of dialed tones.
S12	50	Sets the duration, in fiftieths of a second, of the guard time for the escape code (+++) sequence.

Register	Default	Function
S13	0	Bit-mapped register. Select the bit(s) you want on and set S13 to the total of the values in the Value column. For example, ATS13=20 enables bit 2 (value = 4) and bit 4 (value = 16). Or use ATS*r.b*=0 (OFF) or 1 (ON). For example, ATS13.0=1 .3=1 turns on bits 0 and 3. To turn a bit off, set that bit to zero, as in ATS13.3=0.

Bit	Value	Result
0	1	Reset when DTR drops
1	2	Reverse normal Auto Answer operation: on incoming RING, enter Originate Mode and look for Answer tone
2	4	Disable 250 msec. pause before result code display
3	8	On DTR signal, Auto Dial the number stored in NVRAM at position 0
4	16	At power on/reset, Auto Dial number stored in NVRAM at position 0
5	32	Disable HST (used for testing V.32 *terbo* in Dual Standard modems)
6	64	Disable MNP Level 3 (used for testing Level 2)
7	128	Custom applications

S14	0	Reserved.

Register	Default	Function
S15	0	Bit-mapped register. To set the register, see the instructions for S13.

Bit	Value	Result
0	1	Disable the modem's extra high-frequency equalization if it causes problems on shorter-link calls—HST-modems only
1	2	Disable online fallback
2	4	Disable 450 bps back channel—HST only
3	8	Reset non-ARQ mode Transmit buffer from 1.5K bytes to 128*
4	16	Disable MNP Level 4; retransmitting the larger Level 4 data blocks may be a problem if you expect a great number of errors during a call
5	32	Set backspace key to delete
6	64	Some earlier 2400 bps MNP modems, not made by U.S. Robotics or Microcom, were not fully compatible with the MNP protocol. If you have difficulty making a successful 2400 bps MNP connection with a remote MNP modem, it may be because of this incompatibility. Set S15 to 64 and try again to make the connection.
7	128	Custom applications only

* The default 1.5K byte non-ARQ buffer allows data transfer with X- and Ymodem-type file transfer protocols without using flow control.

The 128-byte option allows remote users with slower modems to stop data you're transmitting from scrolling off their screens. When remote users send your computer an XOFF (<Ctrl-S>) and you stop transmitting, the data in transit from your modem's buffer doesn't exceed the size of their screen.

Register	Default	Function
S16	0	Bit-mapped test register. To set the register, see the instructions for S13. For information on testing, see Appendix G. **Bit Value Result** 0 1 Analog Loopback 1 2 Dial test 2 4 Test pattern 3 8 Remote Digital Loopback 4 16 Reserved 5 32 Reserved 6 64 Reserved
S17	0	Reserved.
S18	0	Test timer for software-initiated loopback testing (&T*n*), disabled when S18 is set to 0. See Appendix G. Used to set the duration of testing, in seconds, before the modem automatically times out and terminates the test.
S19	0	Sets the duration, in minutes, for the Inactivity Timer. The timer activates when there is no data activity on the phone line and at the timeout the modem hangs up. S19=0 disables the timer.
S20	0	Reserved.
S21	10	Sets, in 10-millisecond units, the length of Breaks sent from the modem to the computer or terminal. Applies to ARQ mode only.
S22	17	Stores the ASCII decimal code for the XON character.
S23	19	Stores the ASCII decimal code for the XOFF character.
S24	150	Sets the duration, in 20-millisecond units, between pulsed DSR signals when the modem is set to &S2 or &S3. The default is 3 seconds.

Register	Default	Function
S25	0	Reserved.
S26	1	Sets the duration, in 10-millisecond units, of the delay between RTS and the modem's CTS response in synchronous mode.
S27	0	Bit-mapped register. To set the register, see the instructions for S13.

Bit	Value	Result
0	1	Enable ITU-T V.21 modulation at 300 bps for overseas calls. In V.21 mode, the modem answers both Bell 103 and V.21 calls, but only originates V.21 calls.
1	2	Enable unencoded (non-trellis-coded) modulation in V.32 mode; this option is part of the ITU-T V.32 recommendation, but is rarely used.
2	4	Disable V.32 modulation; used for testing HST modulation in Dual Standard modems.
3	8	Disable 2100 Hz answer tone to allow two V.42 modems to connect more quickly.
4	16	See next page.
5	32	See next page.
6	64	Reserved.
7	128	Unusual software incompatibility. Some software may not accept 7200, 12000, 14400, 16800, 19200 and 21600 bps result codes. This setting disables the codes and displays the 9600 code instead. The call's actual rate can be viewed on the ATI6 screen.

continued on following page

Register	Default	Function
		Error control handshaking options: select the total values of bits 4 and 5.

Bit 4	Bit 5	Result
0	0	Complete handshaking sequence: V.42 Detection, LAPM error control, MNP
16	0	Disable MNP
0	32	Disable V.42 Detection and LAPM
16	32	Disable Detection phase, if you know that the remote modem does LAPM, but not the Detection phase.

S28	8	Sets the duration, in tenths of a second, of the extra 3000/600 Hz answer tones sent during V.32 handshaking. Default = 8 (.8 seconds). This gives V.32 modems additional time to connect in V.32 mode before timing out. If there is difficulty answering older, manually operated V.32 modems, for example, modems that require a button to be pushed in order to dial, try lengthening the duration of the extra tones. Setting S28 to zero eliminates the extra tones, resulting in a faster connect time if, for example, the modem is set to use V.21 modulation (300 bps) or V.23 modulation (1200 bps). Sets the duration, in 1/10ths of a second, of the V.32 handshake.
S29	20	Sets the duration, in tenths of a second, of the answer tones sent during V.21 handshaking. Default = 20 (2 seconds). This gives V.21 modems additional time to connect in V.21 mode before timing out.

Register	Default	Function
S32	9	Sets the function for the voice/data switch. This is not a bit-mapped register. Select the value for the desired function, for example, ATS32=6. **Value Result** 0 Disabled 1 Voice/data, Originate mode. See bit 9. 2 Voice/data, Answer mode 3 Redial last number 4 Dial number stored at position 0 5 Auto Answer on/off toggle 6 Reset the modem 7 Initiate Remote Digital Loopback 8 Busy out phone line toggle 9 Default if a command string is stored with the &ZC=string command. When voice/data switch is pushed and &ZC has been enabled, modem executes stored command string. Otherwise acts like bit 1, Originate mode
S33	0	Bit-mapped register. See instructions for S13. **Bit Value Result** 0 1 Enable HST cellular

Register	Default	Function
S34	0	Bit-mapped register. See instructions for S13.

Bit	Value	Result
0	1	Disable V.32 *terbo*. Used for troubleshooting; U.S. Robotics' Technical Support may require that you disable V.32 *terbo* for testing purposes.
1	2	Disable the modem's enhanced, proprietary V.32 *terbo* modulation. Used for troubleshooting
2	4	Disable the faster retrains that occur during proprietary V.32 *terbo* modulation. Used for troubleshooting
3	8	Enable V.23. Required for some British connections
4	16	Change MR LED to DSR
5	32	Enable MI/MIC; see Appendix F.
6	64	Disable the remote access busy message.
7	128	Disable V.32 *terbo*.

Register	Default	Function
S38	0	Sets the duration, in seconds, before a forced hang-up and clearing of the Transmit buffer, when DTR drops during an ARQ call. This is provided to allow time for a remote modem to acknowledge receipt of all transmitted data. Default = 0: the modem immediately hangs up when DTR drops. If the modem receives the ATH command, it ignores S38 and immediately hangs up.
S41	0	Sets the number of allowable remote access login attempts, thus enabling or disabling remote access. The default setting of zero allows no remote login attempts, thus disabling remote access. A value of 1 or greater enables remote access. If the number of unsuccessful login attempts exceeds the limit set by this register, the modem returns online and any further login attempts during the remainder of that connection are refused.
S42	126	Stores the ASCII decimal code for the remote access escape character. The default character is a tilde (~).
S43	200	Sets the duration, in fiftieths of a second, of the guard time for the remote access (~~~~) sequence.
S44	15	Sets the duration, in seconds, of the delay between when the modem senses loss of carrier and when it attempts to re-establish a leased-line connection.

Register	Default	Function
S51	0	Bit-mapped register. See instructions for S13. **Bit** **Value** 0 1 Disable MNP/V.42 for V.22 (1200 bps) 1 2 Disable MNP/V.42 for V.22 *bis* (2400 bps) 2 4 Disable MNP/V.42 for V.32/V.32 *bis* (9600/14,400 bps). 3–7 — Reserved
S52	Reserved.	
S53	0	Bit-mapped register. Select the dial security features you want enabled by setting S53 to the total of the values in the Value column in the table below. For example, if you want dial security and prompting enabled, set S53=3, which enables bit 0 (value = 1), bit 1 (value = 2). Set S53=5 if you want dial security (bit 0, value = 1) and local-access password protection (bit 2, value = 4) enabled. Or use ATS*r.b*=0 (OFF) or 1 (ON). For example, ATS53.0=1 .2=1 turns on bits 0 and 2. To turn a bit off, set that bit to zero, as in ATS53.2=0. **Bit Value Result** 0 0 Dial security disabled 0 1 Dial security enabled 1 0 Prompting disabled 1 2 Prompting enabled 2 0 Local-access password protection disabled 2 4 Local-access password protection enabled

ASCII CHART

ASCII CHART											
DEC	HEX	CHAR	DEC	HEX	CHAR	DEC	HEX	CHAR	DEC	HEX	CHAR
00	00	NUL	32	20	SP	64	40	@	96	60	`
01	01	SOH	33	21	!	65	41	A	97	61	a
02	02	STX	34	22	"	66	42	B	98	62	b
03	03	ETX	35	23	#	67	43	C	99	63	c
04	04	EOT	36	24	$	68	44	D	100	64	d
05	05	ENQ	37	25	%	69	45	E	101	65	e
06	06	ACK	38	26	&	70	46	F	102	66	f
07	07	BEL	39	27	'	71	47	G	103	67	g
08	08	BS	40	28	(	72	48	H	104	68	h
09	09	HT	41	29	)	73	49	I	105	69	i
10	0A	LF	42	2A	*	74	4A	J	106	6A	j
11	0B	VT	43	2B	+	75	4B	K	107	6B	k
12	0C	FF	44	2C	,	76	4C	L	108	6C	l
13	0D	CR	45	2D	–	77	4D	M	109	6D	m
14	0E	SO	46	2E	.	78	4E	N	110	6E	n
15	0F	SI	47	2F	/	79	4F	O	111	6F	o
16	10	DLE	48	30	0	80	50	P	112	70	p
17	11	XON	49	31	1	81	51	Q	113	71	q
18	12	DC2	50	32	2	82	52	R	114	72	r
19	13	XOFF	51	33	3	83	53	S	115	73	s
20	14	DC4	52	34	4	84	54	T	116	74	t
21	15	NAK	53	35	5	85	55	U	117	75	u
22	16	SYN	54	36	6	86	56	V	118	76	v
23	17	ETB	55	37	7	87	57	W	119	77	w
24	18	CAN	56	38	8	88	58	X	120	78	x
25	19	EM	57	39	9	89	59	Y	121	79	y
26	1A	SUB	58	3A	:	90	5A	Z	122	7A	z
27	1B	ESC	59	3B	;	91	5B	[	123	7B	{
28	1C	FS	60	3C	<	92	5C	\	124	7C	|
29	1D	GS	61	3D	=	93	5D	]	125	7D	}
30	1E	RS	62	3E	>	94	5E	^	126	7E	~
31	1F	US	63	3F	?	95	5F	_	127	7F	DEL

APPENDIX C. DIAL SECURITY AND REMOTE ACCESS OPERATIONS

DIAL SECURITY

Dial Security is designed to protect networks and data centers from unauthorized access. A security administrator is responsible for setting up Dial Security and for configuring the security parameters on the data center's or network's host modem.

Dial Security is available with one of the three following options, or a combination of them.

- Autopass—when the calling or *remote* user's modem is set for Dial Security, it requests a V.42 error correcting connection, and automatically sends an autopass password. Both modems must be U.S. Robotics modems with Dial Security.
- Prompting—if the remote modem doesn't make a V.42 connection or does not send an autopass password, the caller is prompted for a password.
- Dialback—once a connection is made, the host disconnects and dials back the remote modem at a predefined number or allows a new number, depending on the security setup.

NOTE: The system administrator must set up and enable Dial Security accounts before remote users can set up their modems for Dial Security or call in.

WHAT THE SECURITY ADMINISTRATOR NEEDS TO DO

Setting Up Security

Before the security administrator activates Dial Security, the following steps must be followed, **in the listed order**.

1. Set modem to load from NVRAM
2. Set up accounts
3. Set up a local access password
4. Enable Dial Security

1. SET MODEM TO LOAD FROM NVRAM

The modem is shipped from the factory with DIP switch 10 OFF so that it loads the settings stored in NVRAM. Check DIP switch 10 to be sure it is OFF. If you have to reset DIP switch 10, do a power-on or ATZ reset so that the proper setting is in effect.

Dial Security parameters can be erased by setting DIP switch 10 ON and resetting the modem. The modem will load the factory defaults, and Dial Security will be disabled. If the security administrator sets up new accounts using the % commands, they are automatically saved to NVRAM. The Dial Security features (S-Register 53 commands), such as prompting, need to be superseded by the &W command to be saved to NVRAM.

2. SET UP ACCOUNTS

The security administrator has ten accounts available, numbered 0–9. Each account has five possible fields, as shown in the following table.

Password Enabled	Account Enabled	Dialback Enabled	Allow New Number	Dialback Number
8 chars. max. ASCII 32-127	YES/NO	YES/NO	YES/NO	up to 37 characters (0–9 #*,/:"! PST@R)

Account Guidelines

Password

The maximum number of characters for the password is eight (ASCII decimal characters 32–127). The password is case sensitive, so be sure to enter it in the exact form it appears in the password field. If the password is BOB, do not enter Bob.

Account Enabled

After all the correct account information is entered, this function is set to YES. It can be disabled if the account information is not complete, and is helpful if the security administrator needs to edit the account.

Dialback Enabled

When enabled, the host modem checks the phone number field (Dialback Number), hangs up and dials that number.

Allow New Number

When dialback is enabled, but a new number is allowed, the dialback number field is ignored. Before disconnecting, the host modem prompts for a new number; then it hangs up and dials the remote modem at the new number.

Dialback Number

This function allows a maximum of 37 characters in a dialback string, including the following dial options: 0–9 #*,/:"!PSTW@R. The modem counts, but ignores, punctuation characters such as parentheses and hyphens. It does not count spaces, the AT prefix or the Carriage Return (Enter key) required to executed the command.

Account Configuration

The %A*n* command is used to configure accounts, where *n* is the account number, 0–9, and is followed by account functions separated by commas.

AT%A0=William,Y,Y,N,1-419-555-5555 <Enter>

This example instructs the modem to store the configuration for account 0: password, account enabled, dialback enabled, disallow a new number, and a dialback phone number. The %A*n* command must include the equal sign (=).

Each function can be configured independently. If a field is to remain blank, just insert a comma, as shown in the following command which allows the remote user to supply a different dialback number than the stored dialback number.

AT%A0=,,,Y,, <Enter>

The following example sets the password (FINANCE) and enables account 3 without any other security options like dialback.

AT%A3=FINANCE,Y,,,, <Enter>

Inserting spaces between commas or between fields and commas will invalidate the command.

NOTE: Only the security administrator can change the status of accounts and edit the account functions.

3. SET UP A LOCAL ACCESS PASSWORD (%L)

At least one Dial Security account must be set up before the local access password is selected by the security administrator. The password, which protects the integrity of the accounts by denying access by remote users, must be the same as one of the enabled account passwords, and must be chosen BEFORE Dial Security is enabled.

The local access password (%L) in this example is the same as the password in account 5.

AT%L=PW5 <Enter>

Local Password Protection

Local password protection is determined by the bit value of Register S53.2. Once the security administrator enables it, the remote user cannot change the local access password.

S53.2=1	Enables password protection.
S53.2=0	Disables password protection. All security functions are unprotected.

4. ENABLE DIAL SECURITY

Dial Security is available with autopass, prompting, dialback, or a combination of the three. The security administrator must know what types of modems are being used by the remote users and set the Dial Security parameters accordingly.

For example, if the remote modem does not have Dial Security, it cannot send an autopass password, so autopass cannot be enabled on the host modem.

Table C.1 shows the parameters needed to enable Dial Security features. Note for each setting, DIP switch 10 is OFF. The first example enables Dial Security and autopass; the second enables prompting. The &W command saves the settings to NVRAM.

ATS53.0=1 &W <Enter>

ATS53.1=1 &W <Enter>

Function	Register S53.0=1	S53.1=1	S53.2=1	Disable Dial Security S53.0=0
Account Setup (%A)				•
Set Local Password (%L)				•
Account Access (%S)				
Erase Acct. Info. (%E)	•			
Protect Local Password	•	•	•	
Enable Dial Security	•			
Autopass	•			
Prompting	•	•		
Dialback	•			

Table C.1—Dial Security Functions for Host

S53 is a bit-mapped register. Select the bit(s) you want on and set S53 to the total of the values in the Value column in the table below. For example, ATS53=7 enables bit 0 (value = 1), bit 1 (value = 2), and bit 2 (value = 4). **REMINDER:** The S53 value must be saved to NVRAM with the &W command. Otherwise, when the modem is reset the modem will default to S53=0, Dial Security disabled.

Bit	Value	Result
0	1	Modem's dial security enabled.
1	2	Prompting enabled.
2	4	Local-access password enabled.

Autopass

When the security administrator enables autopass, the remote modem must send an autopass password to connect.

If the remote user sends the wrong password, or the remote modem doesn't have Dial Security, the host modem returns an Invalid Password message and hangs up.

If the passwords match, but the host and remote modems are incompatible, for example, the host modem is set to &M1 for

synchronous calls, and the remote modem is set to &M4, the call is disconnected.

Autopass is the only allowable Dial Security setting for synchronous connections. Prompting and dialback enabled are impossible.

NOTE: If the remote user sends an autopass password, and the host modem has disabled Dial Security, the remote modem hangs up.

Prompting

When the security administrator enables prompting, the remote caller must match one of the account passwords to connect.

If the remote modem doesn't have Dial Security or Dial Security is disabled, rather than disconnect, the host modem checks the &M settings, and hangs up if they aren't compatible.

If the modems are compatible, the host modem prompts the caller for a password, and waits 60 seconds before disconnecting. The host modem reads the password and checks each of its active Dial Security accounts for a match. If the password is invalid, the host modem allows two more chances before disconnecting.

If an autopass password isn't sent because the remote user disables Dial Security or has a modem without Dial Security, the host modem allows the user three attempts to match the autopass password.

The host modem allows local access if the passwords match, the account is enabled and dialback is disabled. If dialback is enabled, the host modem disconnects (the remote user sees a NO CARRIER message), and dials the remote modem.

Dialback

Dialback, like the allow new number and the other account functions, has to be enabled before Dial Security is enabled. The following example configures account 6 for dialback enabled.

```
AT%A6=,,Y,,,
```

For more information on setting up accounts, see *Account Configuration*, earlier in this appendix.

When the host modem receives a valid password, and an account's dialback field is enabled, the host disconnects and dials back the remote modem, typically at the number stored in the phone number field.

However, if the account's allow new number field is enabled, the host prompts the remote user for a new number before hanging up, and then dials back. After reconnecting, the host modem rechecks the password.

Account Status

For the system administrator to view the account information, the following command must be typed.

ATI10 <Enter>

This command is only valid for the remote user if local access security is disabled.

Account Access (%S)

The security administrator can access accounts two ways once Dial Security is enabled: disable dial security and edit the accounts using the %A*n*= command, or type the following command which allows access to the accounts without disabling security.

AT%S=(*password*) <Enter>

This command echoes the local access password and is case sensitive. If the password is Bob and is entered as BOB, for example, an OKAY is displayed. However, if the administrator tries to type another command, for example, ATI10 <Enter> to view accounts, an Access Denied message is displayed. Be sure to enter the password the exact way it appears in the local access password field.

Erasing Account Information (%E)

Once the accounts are accessed using the %S command, the security administrator can use the %E command to edit them.

%E	All information in accounts 0–9 erased.
%E=1	Local access password erased.
%E=2	Autopass password erased.

%E=3	Passwords in accounts 0–9 erased.
%E=4	Phone numbers in accounts 0–9 erased.
%E=5	Account fields Account enabled, Dialback and New Number are disabled.

To edit an individual account or an individual account field, see *Set Up Accounts* earlier in this appendix.

ON THE REMOTE SIDE

Remote User's Password (%V)

If autopass is enabled on the host modem, the remote user must do the following:

1. Set the modem to automatically answer incoming calls.
2. Set up a valid autopass password.
3. Enable Dial Security to connect to the host modem.

If the host modem qualifies an autopass password, and dialback is enabled, the host disconnects the incoming call and dials back the remote caller. The Courier is shipped with DIP switch 5 ON, Auto Answer suppressed. To set the modem to automatically answer incoming calls, set DIP switch 5 OFF and reset the modem (ATZ <Enter>).

Or set the modem to answer on the first ring by typing the following command, and save it to NVRAM with the &W.

AT S0=1 &W <Enter>

To get a valid account and to be able to set up an autopass password, the remote caller should contact the security administrator. The following command sets the remote user's autopass password to the password in the host's account 9.

AT%V=PW9 <Enter>

The remote user can also type out the password corresponding to a host's account, as in the following example which sets the remote user's autopass password to Ryan, which is the same as the host's account, 9.

AT%V=Ryan <Enter>

NOTE: The autopass password is case sensitive and must match the security administrator's account. In addition, the host's local access password and the remote autopass password can be the same.

To display your autopass password, type the following command. The password appears in the righthand column below FORCED AUTOPASS.

AT I10 <Enter>

Once the autopass password is set, Dial Security must be enabled with the following command.

ATS53.0=1 &W <Enter>

NOTE: All three of these conditions must be met before the remote modem can make a Dial Security connection.

Function	Register S0=1	S53.0=1
Enable Auto Answer	•	
Set Remote User Password (%V)		•
Enable Dial Security		•

Table C.2—Dial Security Settings for Remote

Remote modems without Dial Security

If the remote modem does not have Dial Security, autopass is impossible. The following guidelines have to be met:

- Remote user must enable automatic answering. (For a Courier, set DIP switch 5 OFF, and S0=1. See description on previous page, or see the remote modem's documentation.)
- Security administrator must enable prompting

Optionally, the security administrator can enable dialback and allow new number features.

Stored Phone Numbers (&Zn=s) and Account(%A) Phone Numbers

The &Z*n*=s command, where *n* is the number and *s* is the number string, allows ten stored phone strings (0–9). This command can only be used when local access security is disabled. Note, however, that entering an &Z*n* command fills in the phone number in the corresponding account (%A) field, as shown in the example below where 555-5555 fills in account 3.

ATZ3= 555-5555

CONFIGURING DIAL SECURITY REMOTELY

The security administrator can configure account information from a remote site, using the following procedures.

NOTE: Steps 1 and 2 must be completed at the local modem before remote configuration is possible.

1. Enable the local modem's remote access by setting Register S41 to a value of 1 or greater, to set the number of login attempts.
2. Assign a remote access password that allows viewing and configuration privileges by typing the following command.

   AT%P1=[password] <Enter>

3. From the remote site, connect to the local modem using Dial Security. Once a connection is made, follow the instructions for beginning a remote access session as described later in this appendix.
4. When remote access has been granted, use the %S= command to access the Dial Security accounts.
5. If you wish, you can view account information by typing the following Inquiry (I) command.

   AT I10 <Enter>

6. Make any configuration changes and save them immediately by typing the following command.

   AT %C2 <Enter>

7. To end the remote session and reactivate local access security on the local modem, reset the modem by typing:

   ATZ <Enter>

Warning: If you do not use the ATZ command to end a remote access session, Dial Security will remain disabled and anyone dialing in to the local modem will have access to all Dial Security accounts.

REMOTE ACCESS

You can set a Courier modem so that it can be remotely configured by someone at another modem. This is especially helpful when you have problems making a connection with another modem. For example, if you have trouble connecting with a bulletin board, you can allow the bulletin board operator to dial in to your modem and view its configuration settings. If necessary, the bulletin board operator can send the Courier a configuration string to correct your settings. Another example of how you might use remote configuration is if you want to call into your modem from a remote site and configure it to accept a certain type of call while you're away.

At the Courier Site

Setting the Courier for Remote Access

There are two ways to set the Courier modem for remote access.

- Set Register S41 for a value of 1 or greater. S41 is used to set the number of allowable login attempts, as explained later. A setting of zero allows no login attempts, and thus disables remote access.
- Press and hold down the voice/data switch while powering on the modem. Pressing the switch during power-on causes the modem to perform its normal self-test, enables Auto Answer, enables Remote Access by changing the S41 setting to 1, and disables password security.

Password Security

You can designate two passwords for remote access security, each allowing a different level of access to the remote user. You can assign one password that allows viewing privileges only, whereby the Courier's configuration can be remotely viewed but

not changed. You can assign another password that allows both remote viewing and configuration privileges.

Passwords can be up to eight alphanumeric characters, and are not case-sensitive. Do not enter any other commands before pressing the <Enter> key. To assign a password that allows viewing privileges only, use the following command format.

AT%P0=[password] <Enter>

To assign a password that allows viewing and configuration privileges, use this command format.

AT%P1=[password] <Enter>

NOTE: If you enable remote access by pressing the voice/data switch while powering on the modem, previously set passwords will be erased.

Login Attempts

The Register S41 setting designates the number of allowable login attempts by the remote user, thus enabling or disabling remote access. If the number of allowable login attempts is set to 0, remote access is disabled. If the number of allowable login attempts is set to 1 or greater, remote access is enabled. If the number of unsuccessful login attempts exceeds the limit set by S41, the modem returns online and any further login attempts during the remainder of that connection are refused.

Disabling Password Security

If you want to disable an assigned password (and thereby disable remote access security), use the following command format.

AT%P0= <Enter>

or

AT%P1= <Enter>

If, for example, you disable the %P0 password, the remote user does not need to enter a password for view-only access.

LED Indicator for Remote Access

The Courier's SYN LED flashes to indicate when it is in a remote access session.

At the Other Modem Site

Remote configuration can be performed at any time during an asynchronous connection. The user performing remote configuration can use any modem; it does not have to be a U.S. Robotics model.

1. Make sure the Courier has been set for remote configuration, as described earlier, and establish a connection. It does not matter which modem originates the call.
2. After a connection has been established, send the following escape sequence.

   Pause four seconds,

   type four tildes: ~~~~

   and

   pause another four seconds.

   NOTE: You can change the escape sequence character with Register S42. The pause duration (guard time) can be modified with Register S43. (These values are set at the Courier modem.)
3. When the Courier begins its login sequence, the caller will see the following screen display (or a similar display).

   U.S Robotics Courier 16800 HST Dual Standard *terbo* Fax Remote

   Serial Number 000000A000000001

4. At this point, if password security is active, the caller is prompted for the password.

   Password (Ctrl-C to cancel)?.....

   As described earlier in *Password Security*, entering the password assigned with %P0 allows viewing privileges only. Entering the password assigned with %P1 allows viewing and configuration privileges. Note that there is a 3-minute time limit for entering the password.

   When a password is accepted, the Courier indicates that it

has entered Remote Access mode and the remote prompt appears on the caller's screen.

Access Granted

Remote->

As mentioned earlier, if the number of unsuccessful login attempts exceeds the set limit, the modem returns online and refuses any further login attempts during the remainder of that connection.

5. If password security is not active (no passwords have been set or both passwords are disabled), the Courier automatically enters Remote Access mode and the remote prompt appears on the caller's screen.

   Remote->

6. Once the remote access session has been established, keep in mind that there is a 3 minute inactivity timer. If the modem detects no activity for 3 minutes, it aborts the remote access session and resumes a normal online connection.

Aborting the Request for Remote Access

You can abort the remote access login procedure and return online by pressing the key combination <Ctrl>-C.

Remote Viewing and Configuration

Once you've gained remote access, you can communicate with the Courier as if you were typing commands at its attached terminal or computer. Depending on your access privileges, you can use the regular Courier AT commands.

If you have view privileges only (with Password 0), you can use any of the view commands described in Chapter 5.

If you have view and configure privileges (with Password 1), you can use any of the modem commands, except those commands that cannot be used while online, such as the Dial command. You can also use the remote access commands explained later.

When you make remote configuration changes, the remote

prompt is altered to indicate that changes have been made. The prompt will change from:

Remote->

to

Remote+>

If you restore the original configuration (with %C1, explained next), the original prompt is also restored (back to Remote->), indicating that the original configuration is intact.

By default, configuration changes do not take effect until the connection is terminated (see %C*n*). However, the new configuration is immediately reflected in the information screens (ATI*n*).

Remote Configuration Commands

There are some additional commands that are only executable during a remote access session. These commands are as follows.

%B*n* Configure the Courier's serial port rate.

%B0	110 bps.	%B6	9600 bps.
%B1	300 bps.	%B7	19,200 bps.
%B2	600 bps.	%B8	38,400 bps.
%B3	1200 bps.	%B9	57,600 bps.
%B4	2400 bps.	%B10	115,200 bps.
%B5	4800 bps.		

%C*n* Configuration control.

%C0 Defer configuration. This is the default. Configuration changes are deferred until the call is ended, and take effect for ensuing connections. You do not need to enter this command; it is the default unless you enter one of the following %C values.

%C1 Restore configuration. Use this command to cancel any configuration changes made during remote access, and restore the original configuration. However, commands that have been written to NVRAM (with &W) will not be restored to their previous settings. Additionally, if you have forced immediate configuration changes (with %C2), those changes cannot be reversed with %C1.

%C2 Execute configuration. Use this command to force configuration changes to take effect immediately, during the current connection. We recommend against forcing immediate configuration changes unless absolutely necessary, as this can result in an unreliable connection or even a loss of connection.

%F*n* Configure data format.

%F0 No parity, 8 data bits.
%F1 Mark parity, 7 data bits.
%F2 Odd parity, 7 data bits.
%F3 Even parity, 7 data bits.

Password Commands

%P=*n* Assign password (*n*=0 allow view ; *n*=1 view, configure).

%P*n*=*s* Set the following password string (*s*) at position *n* (*n* = 0 or 1).

%P*n*? Display the password stored at position *n* (*n* = 0 or 1).

Command Format

When typing commands during the remote access session, no delay between command strings is necessary. For example, you can type the following commands without pausing after each one.

- a password: ABCDEF <Enter>
- a configuration string: AT&H1&R2&W <Enter>
- and a request for an information screen: ATI5 <Enter>

The maximum number of characters between carriage returns is 40.

Ending a Remote Access Session

One of three commands ends a remote access session.

- ATZ resets the modem and terminates the connection.
- ATH terminates the connection.
- ATO ends the remote access session, but the modems remain online.

APPENDIX D. TROUBLESHOOTING

You may occasionally encounter one of the problems listed here. They are divided into two categories: before and during the exchange of user information over the data link.

Before Establishment of the Data Link

Your modem . . .

Doesn't answer the phone or go off hook to dial a number

Review the quick configuration guide (labeled *STOP*) that came with the modem or your communications software manual to see what Data Terminal Ready (DTR) operations your software requires. Then check to see if DIP switch 1 is set correctly. Also, check to make sure your terminal or computer is sending a DTR signal via the RS-232 interface.

Doesn't respond OK when you type AT <Enter>

1. Make sure you're typing in either upper case or lower case letters, not a combination, and that you press the Enter key.
2. If you're using a computer, make sure it is in Terminal mode. This is a communications software function. See *Testing the Modem* in Chapter 2.
3. Check to see that your terminal or software is set to the correct bit rate and word length (7 bits with or without a parity bit, or 8 bits and no parity). If you're using a computer, make sure your software is set to the correct communications port.
4. Check that DIP switch 8 is ON, for command set recognition. If the switch is OFF, power off the modem, set the switch ON, and power on the modem again. Try typing AT <Enter> again.
5. Check that DIP switch 3 is ON, for result code display, and that DIP switch 2 is OFF, for verbal result codes. If not, change the switch(es) and type ATZ <Enter>. Or type whichever of these commands is needed:

ATQ0 <Enter> (to enable the message)
ATV1 <Enter> (to display a verbal message)

6. Review the quick configuration guide (labeled *STOP*) that came with the modem or your communications software manual to see what Carrier Detect (CD) operations your software requires. Then check to see if DIP switch 6 is set correctly.

7. A rare condition is that your terminal or computer reverses the send/receive functions at the RS-232 interface. See the description for Quad switch in Appendix B, and your equipment documentation.

Displays double characters

Both your modem's and software's local echo are on. You can turn your software's local echo off. Or turn the modem's echo off by either resetting DIP switch 4 and sending the modem the ATZ command, or by sending the modem the ATE0 command.

Your computer . . .

Reacts as though a data link has been established, but no call has been received

DIP switch 6 is set ON at the factory for Carrier Detect (CD) override, but your system may require that the override be turned OFF.

Review your terminal's manual, the quick configuration guide (labeled *STOP*) that came with the modem or your communications software manual to see what CD operations are required. Then check to see if DIP switch 6 is set correctly.

When the modem is in Answer mode, it acts as though a Carriage Return has been entered, but nothing has been typed at the keyboard

Your software may be misreading signals from the modem as it automatically sends a Carriage Return and a Line Feed before and after the RING and CONNECT messages. Sending the Quiet mode command, ATQ1 <Enter>, should solve the problem.

Both modems . . .

Exchange carrier signals, but fail to establish a communications link

1. If you have a fax modem, make sure it is in the correct mode, fax or data, depending on whether the connection is to be made with a facsimile device or a data modem. See *Fax Operations* in Chapter 4 for information on switching between Fax and Data modes.
2. Asynchronous operations: Check to make sure the proper bit rate, word length, parity and number of Stop bits have been selected. Synchronous operations: review the link instructions in Appendix E. If you've set the modem to the correct configuration, the problem may be with the synchronous adapter or with the system you're trying to call.
3. Check to see that your modem is at the correct B*n* setting to connect with either an HST modem (B1 setting) or V.32 *terbo* modem (B0 setting). Type ATI4 for a display of the Courier's current settings and, if necessary, send the modem the correct setting.
4. If your modem is attempting to answer a V.32 call, you may need to lengthen the extra V.32 answer tones. See S28 in Appendix B.
5. Depending on your model, make sure the modem at the other end of the line is HST compatible, V.32 *terbo* compatible at 14.4K bps, or V.32 compatible at 9600 bps, V.22 *bis*-compatible at 2400 bps, Bell 212A-compatible at 1200 bps, or Bell 103-compatible at 300 bps. These are the common signaling standards for full duplex dial-up network transmission in the U.S.
6. Make sure your modem's connection rate setting, &N*n* is correct for the call. If the connection rate is locked at a speed (&N1–&N10) different from the calling modem's, the Courier hangs up. The factory setting of &N0, variable link operations, allows the two modems to negotiate the highest possible connection rate.
7. If none of the above corrects the problem, it's likely that the quality of the phone connection is poor and that the other modem is missing the signals your modem is transmitting.

The variable quality of phone line connections may be due to any number of conditions in the phone service's equipment or the current environment. Try several calls, and if you still can't get through, try calling another modem. If the second modem accepts your call, the problem may lie with the modem you first tried to call.

During Data Transfer

Your screen displays . . .

Only brackets

Check to make sure that both modems are set to the same bit rate, word length, parity and number of Stop bits. If the settings are correct, the problem may be with the phone line. Try the following measures:

1. Try placing the call again. The phone company routes even local calls differently each time you call.
2. Try calling a different modem to see if the problem persists. The problem may be with the modem you first tried to call.

Random or garbage characters

Check to make sure that both modems are set to the same bit rate, word length, parity, and number of Stop bits.

If the modem is set to a fixed serial port rate (&B1) and your software is fixed at 19.2K, 38.4K, 57.6K, or 115.2K bps, the reason may be one of the following:

1. Your computer may not support the high rate. If this is the case, fix your software rate at 9600 bps and disable high-speed V.32 *terbo* modulation: ATS34=3 or ATS34 .0=1 .1=1.
2. If you use memory-resident programs (TSRs), they may be interfering. Try disabling them before you run your communications software. The same is true of disk-caching programs.
3. Check to see that your software and the modem are set for the same kind of flow control, either hardware or software. Some communications programs also require that you disable the kind you are not using.

Double characters

Your modem's online local echo is on and the remote modem is also echoing. The only way to correct this is to bring the modem back to Command mode (wait one second without transmitting data, type +++, wait another second). Then type the command to turn off your online echo (ATF1 <Enter>).

If DIP switch 9 is OFF (factory setting), the modem hangs up when it returns to Command mode, and you'll have to call again. If DIP switch 9 is ON, the modem maintains its connection. You can return it back online by typing ATO <Enter>.

IF YOU STILL HAVE PROBLEMS

The problems described above are by far the most common ones that users encounter. If the suggestions we've given don't clear up your difficulties, try the following:

1. Review the manual carefully to see if you've missed something.
2. Call or visit your dealer. Chances are your dealer will be able to give you the assistance you need. This is much more efficient and time-saving than returning the modem to U.S. Robotics.
3. If your dealer can't clear up your difficulties, call the U.S. Robotics Technical Support Department at 800-982-5151, or send a fax to 708-982-0823. Our Service Representatives will be happy to give you assistance over the phone Monday through Friday from 8:00 A.M. to 6:00 P.M. (Central Time Zone).
4. If necessary, the Service Representative you talk to may give you a Return Materials Authorization (RMA) number. Modems without an RMA number will not be accepted.
5. If you do return the modem to us, please use the following procedures.
    a. Ship the unit, postage paid, in its original container. If the original container is not available, pack the modem carefully in a strong box of corrugated cardboard with plenty of packing material.

b. Be sure to include your RMA number inside the package, along with your name and address. Put your return address and your RMA number on the shipping label as well.

c. Ship the well-packed modem to the following address.

   Technical Support Department
   U.S. Robotics, Inc.
   8100 North McCormick Boulevard
   Skokie, Illinois 60076-2999

d. Please note that U.S. Robotics will not accept packages sent COD, so be sure to send the modem postage paid.

e. U.S. Robotics will repair your modem and return it to you via United Parcel Service.

APPENDIX E. SYNCHRONOUS AND DEDICATED AND LEASED LINE OPERATIONS

SYNCHRONOUS APPLICATIONS

Synchronous mode is required for users who need to call, or receive calls, from a *Host* computer of a large network. The Host is usually a mainframe. There are two ways the Courier can operate in synchronous mode:

- Selecting the ITU-T standard V.25 *bis* protocol, which formats data in HDLC or character-oriented frames. This method is used by mainframe operators and synchronous terminal users.

  V.25 *bis* acts as an interface between the mainframe and modem, sending synchronous responses between the modem and the mainframe. An asynchronous device or a "dumb" terminal is used to configure the modem before it dials out in synchronous mode.

- Dedicating a PC as a synchronous device by installing the proper hardware and software so it can communicate with a mainframe. The modem is configured and dials out in asynchronous mode, then switches to synchronous mode once a connection is made.

GENERAL REQUIREMENTS

Courier modems in asynchronous mode adapt to many conditions of remote asynchronous modems. But synchronous connections to a mainframe require strict adherence to specific operating parameters. If you are operating a terminal designed for a particular network, you probably need only set the Courier properly before calling or answering.

NOTE: The term *DTE* in the following discussion means Data Terminal Equipment, the end-to-end equipment involved in data communications. DTE denotes your terminal or computer and the remote computer.

What You Need to Know

The network's communications management staff can supply information on the following requirements:

- The protocol needed for your calls
- The software support needed to log into the network, for example, a specific communications package or interface board
- The phone number, if you will be calling instead of answering
- Any restrictions about when you can call

The RS-232 Interface

Transmit and Receive synchronous timing pins are required at the RS-232 interface. You'll need either pin 15 or pin 24 for Transmitter timing signals, depending on whether the modem (pin 15) or the DTE (pin 24) generates the signals. You'll also need pin 17, for Receiver timing signals. If you're building your own cable, review the *RS-232 Interface*, in Appendix B.

Protocol Compatibility

The devices at both ends of the link must use the same protocol. These protocols format data into blocks or frames and add control information.

If the modem is in V.25 *bis* mode, the link protocol must be HDLC (High-Level Data Link Control), or character-oriented. If the modem is in Online Synchronous mode it may use HDLC, character-oriented, or another protocol determined by the mainframe manufacturer.

Data Rate Synchronization (&Xn)

During synchronous operations, transmit and receive clocks at both ends of the phone link control the precise timing of the data flow. The communications equipment at the remote DTE and your modem and DTE must all handle the data at the same speed.

The transmit clock timing signals setting, &X*n*, determines whether the modem or DTE will generate the timing signals. For

Online synchronous operations, the source for this setting must be the same on both systems. For V.25 *bis* operations this is not necessary. See *Connection Rates (%Nn, &Nn* later in this appendix).

Most Online synchronous users will require the default setting, &X0.

&X0 The Courier is the source of the Transmit clock timing signals and sends them to your DTE over the RS-232 interface. The DTE rate will follow the connection rates. Default.

&X1 The DTE is the source of the Transmit clock timing signals and sends them to the Courier over the RS-232 interface. This setting is used typically in leased line multiplexed operations. (Multiplexors divide the phone channel so that the channel carries several calls at the same time.)

The DTE ignores the Courier's clock timing signals and negotiates the DTE and connection rates. We do not recommend this setting for modems in HST mode.

&X2 The Courier's Receiver clock is the source of the timing signals. The signals are looped to the Transmit clock and sent to your DTE over the RS-232 interface. This setting is only used in those systems that require synchronization of data flowing in both directions. We do not recommend this setting for modems in HST mode.

V.25 BIS REQUIREMENTS

V.25 *bis* is a ITU-T standard that uses the HDLC or character-oriented protocols to format data.

Before you attempt to connect to a synchronous network, you must configure the modem in command (asynchronous) mode by using either an asynchronous device or dumb terminal. Once the modem is in synchronous mode, it no longer accepts asynchronous commands.

To set the modem, follow the instructions in Chapter 3, *Command Set Usage*. Commands begin with a required AT prefix and end with a required Carriage Return, which we denote with the symbol <Enter>. For example, the following command causes the modem to set the connection rates, enable normal result

codes, enable auto answer, select HDLC as a link protocol, and save the settings to NVRAM. Spaces have been added only for readability.

AT &N0 %N6 X0 S0=1 &M7 &W <Enter>

Be sure that DIP switch 10 is OFF so that the modem loads the settings you've stored in nonvolatile random access memory (NVRAM) when it powers on. Until you customize your own settings, the settings in NVRAM are the same as the factory defaults.

Connection Rate (&Nn, %Nn)

The &N*n* and %N*n* commands work in conjunction with &X*n*. If the modem is set so that it is the source of the Transmit clock timing signals (&X0—default) the %N*n* commands set the computer or terminal-to-modem V.25 *bis* clock speed. If the modem is set to &X1, the computer is the source of the Transmit clock signals, but it still follows the rate set by the %N*n* command. In both cases, the &N*n* command sets the online connection rate.

Sample Settings

In originate mode, if the modem is set to &X0, &N0 and %N6, it will establish the highest possible connection rate (&N0), but will be limited to 9600 bps because the %N6 command sets the modem's clock speed at 9600 bps.

In answer mode, if the modem is set to &X0, &N0 and %N7, for example, it tries to connect at the highest possible speed negotiated by the two modems. If, however, the modem is set for a specific value like &N7 (12200 bps) instead of &N0, the modem ignores the %N*n* command and tries to connect at that &N*n* speed. If it doesn't connect, it hangs up.

Unlike the &N*n* command, setting a specific rate with the %N*n* command doesn't fix the connection rate. If the modem is set for &X0, &N0 and %N6, for example, and doesn't make a connection at 9600, it will drop down to the next available speed of the remote modem. The modem negotiates the highest possible connection rate, depending on the remote modem's capabilities.

To avoid confusion, we recommend that the modem be set with a fixed rate between the computer or terminal and modem

(%N*n*) and that the connection rate (&N*n*) be set to the same rate.

The &N*n* rates are as follows:

&N0	Variable (default)	&N6	9600 bps
&N1	Reserved	&N7	12K bps
&N2	1200 bps	&N8	14.4K bps
&N3	2400 bps	&N9	16.8K bps (HST–to–HST or *terbo*–to–*terbo* only)
&N4	4800 bps		
&N5	7200 bps	&N10	19.2K bps (*terbo*–to–*terbo* only)

If &N*n* is set for 2–10, the modem ignores the %N*n* rate and follows the &N*n* rate to set the Online connection rate.

If %N*n* is set to 0 or 1, you will receive an error message since they are not valid values. The %N*n* rates are as follows:

%N0	Reserved	%N6	9600 bps (default)
%N1	Reserved	%N7	12.2K bps
%N2	1200 bps	%N8	14.4K bps
%N3	2400 bps	%N9	16.8K bps
%N4	4800 bps	%N10	19.2K bps
%N5	7200 bps		

Result Codes (Xn)

The Courier displays normal or extended synchronous result codes, depending on the setting of the X*n* command. By default, the modem is set to X1 for extended result codes. To change to normal result codes, set the modem to X0.

The normal result codes return messages such as VAL or INV (VALID or INVALID), whereas the extended codes offer explanations—INVPS (INVALID Parameter Syntax Error).

Automatic Answering (S0=1)

When the Courier is operating in V.25 *bis* mode, it ignores the DIP switch 5 setting, which controls Auto Answer. To set the modem to automatically answer incoming calls, set the modem to S0=1, so it answers on the first ring. You can substitute a higher value. See the S-Register summary in Appendix B.

Suppressing Auto Answer

To disable Auto Answer, set the modem to answer on zero rings, S0=0.

Choosing a Synchronous Protocol (&Mn)

Once the &X*n*, %N*n*, &N*n*, X*n*, S0 commands are configured, you must use the &M*n* command to choose the HDLC or character-oriented link protocol so that your synchronous software can properly format its commands.

&M6 Use the character-oriented protocol for synchronous communications.

The Courier and the remote modem must use the same eight-bit data format. The character length must be 7 bits and either ODD or EVEN parity (ODD is preferred), or 8 bits and NO parity.

&M7 Use the High Level Data Link Control (HDLC), a ITU-T standard, for synchronous communications. HDLC ignores parity.

V.25 bis Commands and Result Codes

Supported V.25 *bis* commands and result codes are listed in Appendix H.

Hanging Up

Since the modem cannot accept commands once it is connected in synchronous mode, you cannot use the ATH (hang up) command or the +++ escape sequence.

The only way for the modem to disconnect is to drop its DTR signal. This is normally done with software. However, if the modem is initially set to S32=6 when it is in asynchronous mode, the modem will reset when the voice/data switch is pressed, thus dropping DTR.

Returning to Asynchronous Mode

Once you've completed a communication session, you can switch between synchronous and asynchronous modes by flipping DIP switch 10 OFF (factory settings, asynchronous

mode) and then ON (NVRAM settings, synchronous mode if the modem is set to &M6 or &M7).

The modem cannot switch between synchronous and asynchronous while it is connected.

ONLINE SYNCHRONOUS REQUIREMENTS

Although personal computers do not usually support synchronous communications, they can be dedicated to do so. If you have a personal computer you must find out what hardware and software you need before setting the Courier for synchronous calls.

The Synchronous Adapter Card

You will probably have to purchase and install a synchronous adapter card. These cards are multifunction boards that provide the following functions:

- A synchronous port from the DTE to the modem.
- One or more synchronous protocols. Be sure to find out which protocol the Host mainframe requires before you purchase an adapter.
- Additional software functions. For example, you need to identify the type of computer or terminal you are using to the mainframe software. You will most likely also have to specify your application, that is, identify the mainframe resources you want to use.

Setting the Modem

When the modem is set to Online Synchronous mode, it remains in command (asynchronous) mode until it makes a synchronous connection with a remote modem. Upon connection, the Courier enters synchronous mode and sends synchronous timing signals to your DTE.

Because the modem will not accept commands when it is in synchronous mode, you will have to configure it in asynchronous mode before trying to connect to a synchronous network.

NOTE: Be sure that DIP switch 1 is OFF (factory setting). The Data Terminal Ready (DTR) override must be OFF so that the Courier detects when the DTE raises and lowers the DTR signal.

To set the modem, follow the instructions for issuing commands in Chapter 3, *Command Set Usage*. Commands begin with a required AT prefix and end with a required Carriage Return, which we denote with the symbol <Enter>.

For example, the following command causes the modem to set the modulation, the connection rate, and choose a timing source. Spaces have been added only for readability.

AT B0 &N0 &X0 <Enter>

Modulation/Connection rate (Bn, &Nn)

Use the following guidelines for your Courier type.

V.32 terbo modems: If the modem is connecting with another U.S. Robotics V.32 *terbo* modem, set both modems to B0 and to a variable connection rate, &N0. The modems will connect at the highest possible rate.

If the Courier V.32 *terbo* is to connect with a V.32 modem, set the Courier to B0 and try a variable connection rate first, &N0. If that doesn't work, try a fixed connection rate of &N6 (9600 bps) or &N3 (2400 bps).

Modems in HST mode: We do not recommend synchronous communications for modems in this mode because of their asymmetrical modulation, unless you are connecting with another U.S. Robotics modem in HST mode. In that instance, set both modems to B1.

For high speed connections with another modem in HST mode, set both modems to a fixed connection rate, &N6 (9600 bps), &N8 (14.4K bps), or &N9 (16.8K bps). Find out first, however, if the mainframe accepts connection rates over 9600 bps. For 2400-bps connections and lower, set both modems to a variable connection rate, &N0.

Dual Standard HST modems: Set the Dual Standard modem to B0. Try a variable connection rate setting (&N0) first. If that doesn't work, you may have to set a fixed connection rate, for example, &N6 (9600 bps).

NOTE: If your modem is set to a fixed rate, and the remote modem is not set to the same rate, your modem hangs up.

Connection Rate (&Nn)

Use this command to set variable or fixed rates at the link interface. The default is &N0, variable rate. The Courier negotiates with the remote modem for the highest possible connection rate, depending on the capabilities of the remote modem. If &N0 does not work, try a fixed rate.

NOTE: The modem is not capable of connecting at 21.6K bps in synchronous mode.

When you set the modem to a fixed rate it will only connect if the remote modem is operating at the same rate. If not, your modem hangs up.

The fixed rate options are as follows.

&N0	Variable rate	&N6	9600 bps
&N1	Reserved	&N7	12K bps
&N2	1200 bps	&N8	14.4K bps
&N3	2400 bps	&N9	16.8K bps (HST–to–HST only
&N4	4800 bps		or *terbo*–to–*terbo* only)
&N5	7200 bps	&N10	19.2K bps (*terbo*–to–*terbo* only)

Generating Clock Timing Signals

The &X*n* setting specifies whether the Courier or your DTE generates the Transmit clock timing signals for a synchronous call. Most users will require the default setting, &X0. See *Data Rate Synchronization (&Xn)*, earlier in this appendix, for more information.

Dialing Out

The modem's stored command feature (&ZC=*s*) allows you to configure the modem for a synchronous connection and to dial out to the Host computer by just pressing the voice/data switch. Below are our recommended procedures.

1. If your communications software isn't running, load the program and put the computer in Terminal mode, as described in the Chapter 2. Terminal mode allows you to send AT commands directly to the modem.

2. Store a command string (&ZC=*s*) that configures the modem according to the guidelines in Chapter 3, and the Host computer's requirements. In addition, include the &M1 command, to have the modem enter synchronous mode, followed by the appropriate Dial string. The following is an example:

   AT &ZC = &F &X1 &M1 DT5551234 <Enter>

   In the example, &F restores the modem's factory defaults, while &X1, which specifies the computer as the synchronous timing source, is the only non-default setting used besides synchronous mode (&M1). Any non-default settings should follow the &F command. The Dial command should be the last entry before the Carriage Return.

3. Set the voice/data switch to option 9, so that the modem executes the stored command string when you press the switch. Type the following:

   ATS32 = 9 <Enter>

   NOTE: If you usually use the voice/data switch for another purpose, you can include the execute stored command option S32 = 9 in the stored command string. However, the total number of characters may not exceed 30.

   If S32=9 is used with the stored command string it overwrites any other S32 option. Once the communication session is over, you will have to reset S32 if you want to select another option.

4. Press the voice/data switch when you want to connect with the synchronous Host computer. You need not have your communications software loaded at the time.

5. After the call, restore the modem to asynchronous operations by powering it off and on again.

Answering

To configure the modem for Answer mode using the voice/data switch, follow the instructions in the previous section, *Dialing Out*, but with these modifications:

- Insert S0 = 1 in the stored command, Step 2. This sets the modem to Auto Answer.

- Omit the Dial string shown in the same step (DT and phone number).

If you don't wish to use a stored command and the voice/data switch, send the modem the appropriate configuration string, ending with &M1. The following command adapts the dial-out command example. Note again that all non-default settings follow the &F command.

AT &F S0=1 &X1 &M1 <Enter>

The modem responds automatically to an incoming call, enters synchronous mode and, in this case, because it is set to &X1, waits for synchronous timing signals from your DTE.

Hanging Up

The modem remains online until the remote modem disconnects or your software causes the DTE to drop the Data Terminal Ready signal (DTR). The Courier sends the NO CARRIER result code if result codes are enabled, and returns to asynchronous Command mode.

Testing and Inquiry Commands

The modem testing commands, &T*n*, and inquiry commands, I*n*, cannot be used when the modem is operating in synchronous mode.

DEDICATED AND LEASED LINE OPERATIONS

The following operations apply in installations where the modem's phone line is not part of a public-access switched telephone network. Instead, the modem is connected to a special user-installed telephone line or a line that is leased from the telephone company. These lines are often referred to as *dedicated* (to a pair of modems) or *private* lines.

In both types of installation there is a continuous point-to-point connection between two modems. No dialing of phone numbers is required. The modems may be in either Smart or Dumb mode (determined by the position of DIP switch 8).

The User-Installed or Leased Telephone Line

User-installed lines are most commonly 2-wire lines, similar to the 2-wire lines that connect residential phones to the public switched network.

If you are leasing a line from the telephone company, request a 2-wire line, the type of line the modem is designed to work with. If the telephone company only makes a 4-wire line available, you'll need a 4-wire to 2-wire converter at each end of the connection. If the phone company does not install the converters, you will have to supply them.

For optimal operations, we recommend that the physical length of these lines not exceed 5 miles.

Setting the Modem

If the Courier is set to &L1, as described in what follows, and the remote AT-compatible modem has a comparable setting, they automatically connect when they are powered on. They also reconnect, without any operator intervention, if a disturbance on the line is severe enough to break the connection.

Set the modem as follows:

1. Set your terminal or communications software to the rate at which you want the modems to communicate. For example, use a terminal/software setting of 19.2K bps and, if both modems have the capability, they will connect at 14.4K bps. The following instructions assume that you are familiar with

the guidelines on using the &B and &H commands (Chapter 3) and the &W command (Chapter 3).

2. Send the modem the following command:

   AT &B1 &S2 &H1 &L1 &W <Enter>

   &B1 fixes the modem's computer interface rate at 19.2K bps. &S2 causes the modem to send a Clear to Send (CTS) signal *only* after it sends the Carrier Detect (CD) signal, that is, only after it connects with the remote modem. (See the note that follows.) &H1 enables hardware (CTS) flow control.

   &L1 forces the modems off hook at power on and enables them to re-establish the connection should it be broken. &W writes the settings to nonvolatile memory (NVRAM) as power-on defaults.

   NOTE: We recommend using the &S2 setting, to delay CTS until after the connection is made, as a precaution. If the modems are in the process of connecting or reconnecting, the Courier interprets any keyboard data entry, including an accidental key stroke, as a *key-press abort*, and hangs up. Delaying CTS until after carrier detection prevents this from happening, for example, if you are typing data to the remote modem when the modems momentarily disconnect and begin to reconnect. However, you have to set the modem for hardware flow control, &H1.

   If your software or machine does not support Clear to Send (CTS), don't include &S2 and &H1 in the command string as suggested above. Follow the Transmit Data flow control (&H) guidelines in Chapter 3. But keep in mind that if the modems fail to connect or reconnect, the reason could be a key-press abort.

3. Set the modem to load NVRAM settings at power-on, DIP switch 10 OFF. It does not matter if the modem is in Dumb or Smart mode (DIP switch 8).

4. Decide which modem is to be the calling modem and which the answering modem. Set the answering modem to Auto Answer, DIP switch 5 OFF, and the calling modem to Auto Answer suppressed, DIP switch 5 ON.

5. Power off and power on the modems. This initiates the new DIP switch settings and loads the power-on defaults,

including &L1. The modems go off hook and establish the connection.

NOTE: If the modems cannot restore the connection and you could not set the modem to &S2, the reason could be a key-press abort. If the problem persists, however, you may need to call your telephone company to have them check your line.

APPENDIX F. ADDITIONAL OPERATIONS

CONTENTS

CELLULAR OPERATIONS

This function applies to Dual Standard HSTs only. HST cellular modems can be used to answer or originate calls, but are proprietary. They can only connect with other U.S. Robotics Dual Standard modems with HST cellular capabilities.

To enable cellular mode, load the factory setting template 3 by typing the following command.

AT &F3 <Enter>

To save this as your power-on/default setting, type this:

AT &F3 &W <Enter>

The &F3 command sets the serial port rate to 19,200 bps, and formats the data for 8 bits, no parity and no stop bits. The initialization string sent to the modem is shown below.

AT B1 X7 S10 = 30 &B1 &L2 &H1 &I0 &R2

- B1—enables HST modulation
- X7—displays extended result codes including NO DIAL TONE, RINGING, NO ANSWER, and BUSY messages
- &B1—sets the serial port rate so that it remains higher than the connection rate.
- S10=30—sets the modem to wait 3 seconds after loss of carrier before hanging up.
- &L2—enables cellular mode
- &H1—enables hardware flow control
- &I0—disables software flow control
- &R2—sets the modem so it sends received data to the computer or terminal when the Ready To Send (RTS) signal is high, only if the computer or terminal supports RTS.

The modem uses the U.S. Robotics proprietary HST cellular protocol to make connections. The call starts at 1200 bps, a V.42 error control connection is negotiated, then the modem switches to 4800 bps and begins measuring the line conditions. Depending on line conditions, the modem decreases or increases its connection rate, to a minimum speed of 300 bps and a maximum of 12K bps. If a connection terminates before data

transfer is completed, the system tries to re-establish the link and complete the transfer.

If a large number of blocks are being resent (shown by the ARQ LED flashing randomly; some software displays the blocks retransmitted in the file transfer window), you may want to reduce the packet size by doing the following:

1. Be sure DIP switch 9 is ON so that the modem remains online if it receives +++.
2. If DIP switch 9 is OFF, switch it to ON and reset the modem by issuing the ATZ command.
3. Send the modem the escape sequence by typing +++ so that the transmission is interrupted, and wait 1 second.
4. Type AT S33=1 to reduce the packet size.
5. Then type ATO so that the modem returns online and continues to transmit.

NOTE: HST cellular connections can only be made with other U.S. Robotics modems in HST cellular mode. The modem cannot be used to place a voice or data call to another phone or modem when it is in this mode.

VOICE/DATA

The voice/data switch is located on the modem's front panel. While the switch's primary function is to toggle back and forth between voice and data communications, this feature also allows you to perform other functions at the touch of a switch. Use Register S32 to select these functions, as shown in Table F.1

Additionally, the Courier modem allows you to use the voice/data switch to set the modem for remote configuration. This is described in *Remote Access* in Appendix C.

NOTE: Use the voice/data switch when the modem is in Command mode (offline). If you press the switch while the modem is online, the modem hangs up and returns a NO CARRIER result code.

VOICE/DATA OPERATIONS—S32=1, S32=2 OR AT COMMANDS

When you install the Courier, you have the option of plugging your phone into the second modular jack of the modem so it's available for voice calls. You can also switch between the phone and modem during a call.

If the remote modem has handset exclusion, you can change from voice to data and back again, with or without issuing a command.

Handset exclusion means that if the modem is using the phone line, your phone (handset) is automatically disconnected. However, if you keep the handset off hook, once you hang up the modem the handset takes over the phone line and you can use voice communications again. If the remote user does not have handset exclusion, you may not be able to switch back to voice mode successfully once you have switched to Data mode.

The following instructions describe how to toggle voice/data communications with the switch. This is followed by instructions for doing the same thing with AT commands. If the remote user does not have a switch, he or she can follow the instructions for using the appropriate AT command.

Voice/Data Switch—S32=1, S32=2

1. Phone the other user to establish the bit rate, parity, word length and number of Stop bits the other person's modem accepts. (Both modems should be offline, in Command mode.)

   You and the other user must also agree on which modem will go off hook in Originate mode and which in Answer mode. The Courier is factory set to go off hook in Originate mode, S32=1. The Answer modem should have S32 set to 2.

   NOTE: If the stored command string command has been used (&ZC=*s*), the modem will default to S32=9, which executes the stored command string when the voice/data switch is pushed.

   Either party's device can be the originate or answer modem: it doesn't matter who made the phone call. But one modem must first enter Originate mode and the other then enter Answer mode.

2. Without hanging up the phone, press the voice/data switch.

   If S32 is set to 2, Answer mode, press the voice/data switch immediately *after* the remote user forces the remote modem off hook in Originate mode.

3. The other party should force the remote modem off hook in Answer mode by pressing the switch.

   If yours is the Answer modem (S32=2), the other party should press the voice/data switch immediately *before* you do so.

4. If the remote modem has handset exclusion, the remote user should also keep the phone off hook in order to switch back to voice later. If the remote modem doesn't have handset exclusion, you can try to switch back to voice later. Or, you both can hang up your phones as soon as the modems go off hook.

Software Commands—ATD, ATA

If your voice/data switch is set for a function other than voice/data operations and you don't wish to change it, use commands.

1. Call the other user to establish the bit rate, parity, word length and number of Stop bits the other person's modem accepts. Determine which modem will originate and which will answer.

2. If you are to originate the connection, type the following command:

   ATD <Enter>

   NOTE: Be sure the modem is not set to X2, X4, X6 or X7, or it will return the NO DIAL TONE result code and hang up.

3. The other party must then have the remote modem go off hook in Answer mode. The following command is used to do this:

   ATA <Enter>

4. If the remote modem also has handset exclusion, leave both phones off hook in case you wish to switch back again to voice after your data transfer. If the remote modem doesn't have handset exclusion, switching back to voice may not be

successful. If you don't want to switch back to voice later, hang up both phones as soon as the modems go off hook.

ALLOWABLE VOICE/DATA SWITCH FUNCTIONS

Use Register S32 to set the voice/data switch for the function you desire. The default is S32=1—pressing the switch forces the modem off hook in Originate mode. Pressing the switch when you power on the modem causes it to perform a power-on self-test. See Table F.1—S32 Functions below.

S32 Value	Voice/Data Switch Function	Related Command
0	Disabled	—
1	Voice/Data–Originate Mode (Default*)	ATD (Appendix F)
2	Voice/Data–Answer Mode	ATA (Appendix F)
3	Redial Last Number	ATDL (Chapter 3)
4	Dial Number Stored at position 0	ATDS0 (Chapter 3)
5	Auto Answer On/Off Toggle	ATS0=0 or 1 (Chapter 3)
6	Reset Modem	ATZ (Chapter 3)
7	Initiate Remote Digital Loopback	AT&T6, S16=8 (Appendix G)
8	Busy Out Phone Line Toggle	—
9	Execute Stored Command (Default*)	AT&ZC=*s* (Chapter 3, Appendix E, F)

* The modem is shipped from the factory set at S32=9. If a command string has been stored (&ZC=*s*), the modem executes the stored command string when the voice/data switch is pushed. If no command string is stored, S32=9, but the modem acts like it is set to S32=1, Originate mode.

Table F.1—S32 Functions

HEWLETT PACKARD INSTALLATIONS

During error control connections, the Courier recognizes the ASCII ENQ/ACK characters exchanged between many Hewlett Packard host computers and their terminals. The HP host sends the terminal an ENQ character at predefined intervals, and sends no more data until the terminal responds with an ACK character.

Courier modems manage this ENQ/ACK protocol so that communication is speeded up, thereby enabling HP terminals to achieve high speeds on dial-up lines. Special flow control settings, using the &I command, are required for HP users. These settings apply to ARQ connections only and to Courier modems set to either B0 or B1. Disregard other Courier flow control commands.

Set the Courier to Host mode if it is attached to the host computer, or to Terminal mode if it is attached to a terminal, as follows:

Host mode **AT&I3 <Enter>**

Terminal mode **AT&I4 <Enter>**

MI/MIC OPERATIONS

DESCRIPTION

Mode Indicate/Mode Indicate Common (MI/MIC) closure is required by some installations whose existing hardware does the dialing. The modems do not Auto Dial.

In these situations, the modem must be forced off hook in Originate mode. This is done by shorting (closing) two of the pins (not Tip and Ring) in the phone connector. The modem is then ready to go online and accept data when it connects with the number dialed by the system equipment.

Courier modems are shipped with MI/MIC disabled, that is, for normal use. To set the modems for MI/MIC closure, enable bit 5 of Register S34: ATS34=32 or ATS34 .5=1. We recommend that you write that setting to NVRAM as a power-on default.

Once you've set Register S34, have the system force the modem off hook by closing the MI/MIC leads in the phone line connector. The modem's OH (Off Hook) status light, or LED, goes on when the modem goes off hook.

TROUBLESHOOTING

You may find that the modem does not respond to MI/MIC closure, which you can monitor by observing the LED. Or the modem may fail to go back on hook when the computer or terminal drops the Data Terminal Ready (DTR) signal. The probable reason for either of these conditions is that your phone equipment reverses MI/MIC polarity.

It's possible to solve this problem by reversing the modem's MI/MIC wiring. You'll have to dismantle the modem case and reset two switches on the printed circuit board, as follows.

1. Power off the modem and disconnect all of its cables.
2. Turn the modem upside down. Remove the two square vinyl feet near the back of the case, on either side of the bottom label's DIP switch diagram. Be careful to put the vinyl feet aside, upside down, where they won't become stuck to another object.
3. Remove the two Phillips screws located in the wells beneath the vinyl feet.

4. Gently pry off the plastic volume slide-switch cover.
5. Raise the back end of the case bottom until it is at about a 60° angle; lift it away from inside the front of the modem. Put the case bottom aside.
6. Locate the voice/data switch at the front of the modem. Lift up and remove the modem (printed circuit board), carefully easing the voice/data switch out of its opening in the front panel.
7. Turn the modem rightside up and locate jumper switches J4 and J6, near the power-adaptor socket. Use Figure F-1 as a guide.

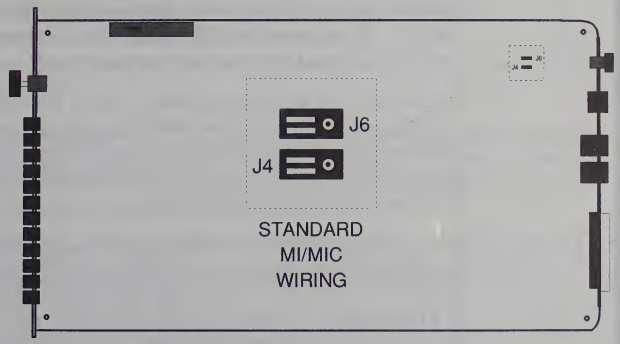

Figure F-1—Courier Modem Board

8. The jumpers are black shunts that cover two out of three upright metal contacts. As shown in the figure, the modem is shipped with the jumpers over the two contacts on each switch that are closest to the front panel. The third contact on each switch is exposed.

   Lift off the jumpers from J4 and J6. Reverse the positions shown in Figure F-1. That is, on each switch, cover the center and rightmost contacts. Make sure the jumpers cover two contacts on each switch, or you'll disable the MI/MIC function.
9. Replace the modem in the case top: ease the voice/data switch into the opening in the front panel and make sure the

back of the board rests on the locator pins at the rear (from which you removed the screws).

10. Reconnect the modem's RS-232, power and phone cables, in that order. Be sure the phone cable is plugged into the jack closest to the center of the modem—the jack represented by the wall jack icon on the case bottom label.

    CAUTION: When you power on the modem there will be potentially hazardous voltage, particularly near the phone jacks. Do not touch the board when the power is on.

11. Power on the modem. Try MI/MIC closure again. Check to see that the Off Hook (OH) status light goes on. If you dialed a number, listen for an answer tone from the remote modem. Then drop the DTR signal. The modem should go on hook and the OH status light should go off.

12. If closure is not working properly, review the steps in this section. Be sure the jumper switches are in the reverse position of those in Figure F-1. If you still have problems, there may be a problem with the phone cable. Or there may be a problem with your hardware.

13. When the equipment is working correctly, replace the bottom of the modem case. Ease the two nibs near the front corners into their openings in the front of the case top, guide the rectangular slot over the volume switch, and ease the back of the case bottom into place. Replace the two screws, the two vinyl feet, and the volume slide-switch cover.

APPENDIX G. MODEM TESTING

Testing is available with the &T command or Register S16. All loopback testing conforms to ITU-T Recommendation V.54. Earlier U.S. Robotics high speed modems, however, did not perform the &T test repertoire.

Only one test can be performed at a given time. If you send a test command while the modem is in test mode, you'll receive an ERROR message.

NOTE: Testing is not available when the modem is in synchronous mode: &M1, &M6, &M7.

TESTING WITH &T

The tests supported through the &T command include analog loopback, digital loopback and remote digital loopback. Users can key in their own data during testing, or use the modem's internal test pattern and error detector.

In all cases, disable error control before testing. If the modem is detecting errors and retransmitting the affected data, your results will be invalid.

During testing, the MR status light flashes.

Ending a Test—&T0, S18

Issuing the &T0 command terminates a test. Alternatively, set Register S18 to a specified number of seconds, for example, S18=10. When the 10 seconds are up, the modem automatically ends the test and returns to Command mode. If the test was Analog Loopback, the &T0 command hangs the modem up. If the test was Digital or Remote Digital Loopback, issue an ATH command to hang up the modem, or an ATZ command to hang up the modem and reset it to its defaults.

NOTE: If you use the S18 test timer, but in the process of testing you issue an ATZ command, S18 resets to zero and the timer is disabled. You cannot store a value for S18 in nonvolatile memory: its power-on and reset default is always zero.

ANALOG LOOPBACK—&T1, &T8

This test checks the operation of the modem's transmitter and receiver. Data flow is shown in Figure G-1.

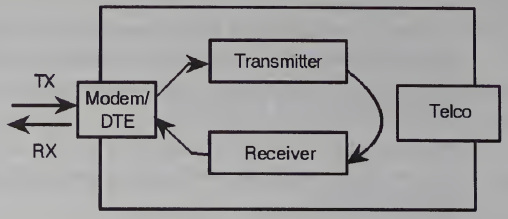

Figure G-1. Data Flow During Analog Loopback

There are two analog loopback options. The first, &T1, involves your typing data that you can verify at your screen.

The second option, &T8, is an internal self-test that does not involve the keyboard or screen. It isolates the modem from the computer interface to give you a more specific result.

NOTE: Dual Standard modems must be set to B0 (default) or tested at *2400 bps or lower* to avoid HST asymmetrical modulation at higher speeds.

&T1

1. If you are testing an HST or Dual Standard modem, set your terminal or software to 2400 bps.
2. The modem must be in Command mode. If you wish, set Register S18 as a test timer, as explained earlier.
3. Send the modem the following command.

   AT &M0 &T1 <Enter>

   The modem disables error control, enters analog loopback (AL) mode, and sends a CONNECT message. The MR status light flashes.
4. Type recognizable data so that you can verify it when it is looped back to the screen.
5. End the test. If you set S18, the modem automatically stops the test at the timeout, exits AL mode and responds OK.

If you didn't set Register S18, wait one second and type +++ to bring the modem back to Command mode. If DIP switch 9 is OFF, the modem also hangs up and ends the test.

If DIP switch 9 is ON, type AT&T0 to end the test. Or send either ATH or the command that resets the modem, ATZ. The latter two commands end the test and hang up the modem. The modem responds OK. If the modem sends an ERROR message, you have issued an invalid command.

6. If there were no errors, reset the modem to &M4, for error control, unless you've issued the ATZ reset command.

   NOTE: If the modem is in online-command mode, that is, still connected to a remote modem, and you send it an &T1 or &T8 command, it drops the call, enters AL mode, sends a CONNECT result and waits for loopback characters.

&T8

This AL option causes the modem to send an internal test pattern to its transmitter and loop it back to the receiver. An internal error detector counts any errors and, when the test is ended, sends the number of errors or 000 (no errors) to the screen.

Since you don't type anything during this test, and the modem does not send anything to the screen, this option verifies only the modem. If there are no errors but your problem continues, it may be at the computer interface.

1. If you are testing an HST or Dual Standard modem, set your terminal or software to 2400 bps.
2. The modem must be in Command mode. If you wish, set Register S18 as a test timer, as explained earlier.
3. Send the modem the following command:

   AT &M0 &T8 <Enter>

   The modem disables error control and enters AL mode. The MR status light flashes. The modem sends its internal test pattern to the transmitter, and loops the pattern back to the receiver. You will not see any data on your screen.
4. End the test. If you set S18, the modem automatically stops the test at the timeout. If you didn't set Register S18, type AT&T0 to end the test. Or use ATH or the command that

resets the modem, ATZ. Both of the latter end the test and hang up the modem.

The modem hangs up and returns a three-digit code, followed by OK. A code of 000 indicates no errors were found. A code of 255 indicates 255 or more errors. An ERROR message indicates that you issued an invalid command.

5. If there were no errors, reset the modem to &M4 for error control unless you issued the ATZ command.

&T2

This option is reserved.

DIGITAL LOOPBACK—&T3

If your modem has passed the AL test, this test can help you locate a problem with a remote modem or the telephone channel. Figure G-2 shows the data flow during DL testing.

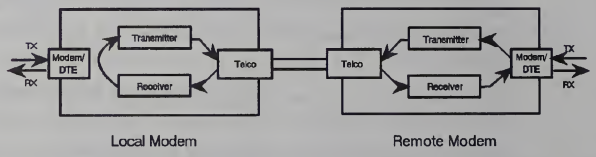

Figure G-2. Data Flow During Digital Loopback

NOTE: This test requires the modem to establish a connection and return to online-command mode in response to the +++ escape code. DIP switch 9 must be set ON so that the modem does not hang up on receipt of the escape code. After you change the switch, issue ATZ to the modem to initiate the new setting.

As with AL testing, HST and Dual Standard modems should be tested at 2400 bps or lower.

1. Set the modem to &M0, to disable error control. HST and Dual Standard modems should be set to 2400 bps or lower to avoid asymmetrical modulation at higher speeds. Establish a connection with the remote modem.

2. Bring the modem back to Command mode with the +++ escape code. Then send it the AT&T3 command. The modem enters DL mode and the MR status light flashes.
3. The remote user should type a short message. It will be looped back by your modem's transmitter for verification on the remote screen. You will not see the message or any other data.
4. When the remote user has completed the test, issue the AT&T0 command to end the test. Or send either ATH or the command that resets the modem, ATZ. The latter two commands end the test and hang up the modem. The modem responds OK. If the modem sends an ERROR message, you have issued an invalid command.
5. Reset DIP switch 9 OFF if you normally use the factory default. Reset the modem to &M4 unless you used the reset command, ATZ.

&T4, &T5

The &T4 option causes the modem to grant a remote modem's request for a Remote Digital Loopback test.

The &T5 option cancels &T4, and the modem fails to recognize such a request. This is the default so that your modem isn't subject to another user calling and tying up your modem without your permission.

REMOTE DIGITAL LOOPBACK—&T6, &T7

This test, like the local digital loopback test, verifies the condition of both modems and the phone link. Data flow is shown in Figure G-3.

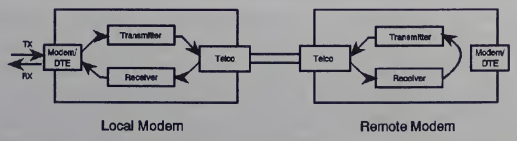

Figure G-3. Data Flow During Remote Digital Loopback

The request for and granting of Remote Digital Loopback testing requires that both modems use ITU-T V.22 standard signaling.

The test must be performed at 2400 bps or lower. If the remote modem does not have the capability or is not set to respond, you will get an ERROR result code.

As with Analog Loopback, there are two Remote Digital Loopback options. If you select &T6, you send keyboard data to the modem and verify it when it is returned over the phone lines and to your screen. If you select &T7, the modem sends its internal test pattern and returns an error count to your screen.

NOTE: Both test options require the modem to establish a connection and return to online-command mode in response to the +++ escape code. DIP switch 9 must be set ON so that the modem does not hang up on receipt of the escape code. If necessary, set the switch ON and then issue the ATZ command to the modem to initiate the new switch setting.

&T6

1. Set the software to 2400 bps or lower. Set the modem to &M0. If you wish, set the S18 timer.

   Establish a connection with the remote modem. If you haven't already done so, arrange with the remote user to cooperate with your testing and, if necessary, set the remote modem to acknowledge the RDL request. For example, older U.S. Robotics high speed modems need to be set to S16=8.

2. Bring the Modem back to Command mode with the +++ escape code. Send it the AT&T6 command. The modem enters RDL mode and the MR status light flashes.

3. Type a short message. It will be looped back to your modem by the remote modem and to your screen for verification. (The remote user will not see your data.)

4. End the test. If you set Register S18 the modem automatically ends the test when the test timeout is reached. If you didn't set S18, type AT&T0 to end the test. Or send either ATH or the command that resets the modem, ATZ. The latter two commands end the test and hang up the modem. The modem responds OK. If you issue an invalid command, the modem sends an ERROR message.

   Data errors indicate a problem with the remote modem or the phone link. If you have not performed analog loopback

testing with your modem, the problem may also lie with your modem.

5. Reset DIP switch 9 OFF unless you normally set that switch ON, and issue ATZ to the modem to initiate the new setting. Reset the modem to &M4 unless you used the reset command, ATZ.

&T7

This test option causes the modem to send an internal test pattern through the Remote Digital Loopback. An internal error detector counts any errors and, when the test is ended, sends the number of errors or 000 (no errors) to the screen.

You don't need to type anything during this test. The modem sends only its final error count to your screen.

1. Set the software to 2400 bps or lower. Set the modem to &M0. If you wish, set the S18 timer.

   Establish a connection with the remote modem. If you haven't already done so, arrange with the remote user to cooperate with your testing and, if necessary, set the remote modem to acknowledge the RDL request. For example, older U.S. Robotics high speed modems need to be set to S16=8.

2. Bring the modem back to Command mode with the +++ escape code. Then send it the AT&T7 command. The modem enters RDL mode and the MR status light flashes.

   The modem sends its internal test pattern to the remote modem, which loops it back to your modem. You will not see the data on your screen.

3. End the test. If you set S18, the modem automatically stops the test when the timer times out. If you didn't set Register S18, type AT&T0 to end the test. Or send either ATH or the command that resets the modem, ATZ. The latter two commands end the test and hang up the modem. The modem responds OK. If you issue an invalid command, the modem sends an ERROR message.

   When you terminate the test, the modem returns a three-digit code, followed by OK. A code of 000 indicates no errors were found. A code of 255 indicates 255 or more errors.

If you've performed an Analog Loopback and know your modem is working properly, errors indicate a problem with either the phone connection or the remote modem.

4. Reset DIP switch 9 OFF unless you normally operate with it ON. Issue an ATZ command to initiate the new switch setting. Reset the modem to &M4 unless you've sent it the ATZ reset command.

TESTING WITH REGISTER S16

Register S16 is a bit mapped register with the following bit functions:

Bit	Value	Function
0	1	Analog Loopback (AL)
1	2	Dial Test
2	4	Test Pattern
3	8	Remote Digital Loopback (RDL)

NOTE: Earlier U.S. Robotics modems require bit 3 to be enabled in order to grant RDL to a remote modem. The modem now requires its default &T4 setting instead. To perform RDL with a U.S. Robotics modem that does not use the &T test repertoire, that modem should be set to S16=8 before it can grant RDL testing.

ANALOG LOOPBACK (AL)—S16=1D

As with the &T AL test, do not attempt this test under error control. HST and Dual Standard modems should be tested at 2400 bps or lower, to avoid asymmetrical modulation at higher speeds.

To use the modem's Test Pattern (S16, bit 2) instead of typing your own data, see *Test Pattern—S16=4* later in this appendix.

1. To initiate testing, type AT&M0S16=1D. The modem disables error control, enters AL mode and sends a CONNECT result code. The MR status light flashes.
2. Type data to the modem for the modem to transmit, loop to its receiver, and output to the screen. An alternative is to use the *Test Pattern*, described later.

3. End the test by not typing anything for one second, then typing three pluses (+++), and waiting another second. This forces the modem back to Command mode. If DIP switch 9 is OFF, the modem exits AL mode and returns to Command mode. If DIP switch 9 is ON, the modem maintains the connection when it receives the +++ escape code. Issue the ATH command to end AL mode.
4. Reset the modem to Data mode, S16=0, and error control (&M4), or issue the ATZ (reset) command.

DIAL TEST—S16=2

The Dial Test is used for factory testing the frequencies of tone values. When S-Register 16 is set to 2 and a single tone is dialed (e.g., ATD7 <Enter>), the modem continues to transmit that tone until you type another Carriage Return.

TEST PATTERN—S16=4

The test pattern can be used instead of your typed data during Analog Loopback (AL) or Remote Digital Loopback (RDL), using &T commands or S16. The test pattern is available at all speeds. At 300 bps, the modem's serial port rate must be fixed (&B1) and the link rate fixed at 300 bps (&N1). At rates over 9600 bps, just set the modem for a fixed serial port rate (&B1).

To use the test pattern during AL testing with S16, type the following command. The test pattern is sent through the loopback.

AT&M0S16=5D

To use the test pattern during RDL testing with S16, type the following command.

AT&M0S16=12

To use the test pattern with the &T AL or RDL tests, insert the test pattern command, S16=4, before issuing the test command. The first of the following commands initiates AL, the second RDL:

ATS16=4&T1
ATS16=4&T6

The test pattern alone (ATS16=4) is used for testing equipment and the phone line. When S16 is set to 4, the modem transmits the test pattern upon connection with a remote modem.

Ending Testing with the Test Pattern

Pressing any character key cancels all test pattern tests and hangs up the modem. If you used Register S16, be sure to reset Register S16 to Data mode when you reset the modem to its error control defaults, for example, ATZ or AT&M4S16=0.

REMOTE DIGITAL LOOPBACK—S16=8

Responding Modem

The responding modem must be ready to act on the Courier's RDL request. U.S. Robotics high speed modems should be set to &T4. If they do not have &T testing capability, they should be set to S16=8.

Initiating Modem

1. If DIP switch 9 is OFF, set it ON so that it does not hang up on receipt of the +++ escape code. Issue an ATZ command to initiate the new switch setting.
2. Set the software to 2400 or 1200 bps. The ITU-T-specified RDL signals are defined only for connections at 2400 or 1200 bps.
3. Disable error control by setting the modem to &M0. Then establish a connection with the remote modem.
4. Bring the modem back to Command mode by sending it the escape code: one second of no data, three pluses (+++), and another second of no data.
5. When the OK result code appears, send the modem the following command.

   ATS16=8 O

   The modem enters RDL mode (S16=8), the MR status light flashes, and the modem goes back online (O command). Then it transmits the ITU-T-defined RDL signals, causing the remote modem to enter RDL mode.
6. Type any data at the keyboard. (Or send the test pattern.)

7. To end the test, send the modem the +++ escape code again to bring it back to Command mode.
8. When the modem sends the OK result, reset the modem to Data mode with the following command.

   ATS16=0

   The modem signals the responding modem that RDL testing is over. Terminate the call as you normally would, and reset the modem to its normal error control setting, &M4 or &M5.

   Or, if you wish to resume data transmission with the remote modem, add the O command to the ATS16=0 string to return the modem online. Keep in mind, however, that error control is disabled. Because error control is negotiated during the connection sequence, its status cannot be changed until the modem is back on hook and in Command mode.

APPENDIX H. GLOSSARY

Cross-references in the following definitions are printed in boldface.

Analog Loopback

A modem self-test in which data from the keyboard is sent to the modem's transmitter, modulated into **analog** form, looped back to the receiver, demodulated into **digital** form, and returned to the screen for verification.

Analog Signals

Continuous, varying waveforms such as the voice tones carried over phone lines. Contrast with **digital signals**.

Answer Mode

A state in which the modem transmits at the predefined high frequency of the communications channel and receives at the low frequency. The transmit/receive frequencies are the reverse of the calling modem which is in **Originate mode**.

Application (application program)

A computer program designed to perform a specific function, such as a word processor or a spreadsheet.

ARQ

Automatic Repeat Request. A general term for error control protocols which feature error detection and automatic retransmission of defective blocks of data. See **HST**, **MNP**, and **V.42**.

ASCII

American Standard Code for Information Interchange. A 7-bit binary code (0's, 1's) used to represent letters, numbers, and special characters such as $, !, and /. Supported by almost every computer and terminal manufacturer.

Asymmetrical Modulation

A duplex transmission technique which splits the communications channel into one high speed channel and one slower channel. During a call under asymmetrical modulation, the modem with the greatest amount of data to transmit is allocated the high speed channel. The modem with less data is allocated

the slow, or back channel (450 bps). The modems dynamically reverse the channels during a call if the volume of data transfer changes.

Asynchronous Transmission

Data transmission in which the length of time between transmitted **characters** may vary.

Because the time lapses between transmitted characters are not uniform, the receiving modem must be signaled as to when the data bits of a character begin and when they end. The addition of **Start** and **Stop bits** to each character serves this purpose.

Auto Answer

A feature in modems enabling them to answer incoming calls over the phone lines without the use of a telephone receiver.

Auto Dial

A feature in modems enabling them to dial phone numbers over the phone system without the use of a telephone transmitter.

Baud Rate

The number of discrete signal events per second occurring on a communications channel. Although not technically accurate, baud rate is commonly used to mean **bit rate**.

Bisync

Binary Synchronous Control. An earlier protocol developed by IBM for software applications and communicating devices operating in synchronous environments. The protocol defines operations at the link level of communications, for example, the format of data **frames** exchanged between modems over a phone line. See **Protocol**, **HDLC**, **SDLC**.

Binary Digit

A 0 or 1, reflecting the use of a binary numbering system (only two digits). Used because the computer recognizes either of two states, OFF or ON. Shortened form of binary digit is **bit**.

Bit Rate

The number of **binary digits**, or bits, transmitted per second (**bps**). Communications channels using telephone channel

modems are established at set bit rates, commonly 110, 300, 1200, 2400, 4800, 9600, and 14400.

BPS

The bits (**binary digits**) per second rate.

Buffer

A memory area used as temporary storage during input and output operations. An example is the modem's command buffer. Another is the Transmit Data flow control buffer used for flow control and to store copies of transmitted **frames** until they are positively acknowledged by the receiving modem.

Byte

A group of **binary digits** stored and operated upon as a unit. A byte may have a coded value equal to a character in the ASCII code (letters, numbers), or have some other value meaningful to the computer. In user documentation, the term usually refers to 8-bit units or characters. 1 kilobyte (K) is equal to 1,024 bytes or characters; 64K indicates 65,536 bytes or characters.

Carrier

A continuous frequency capable of being either modulated or impressed with another information-carrying signal. Carriers are generated and maintained by modems via the transmission lines of the telephone companies.

CCITT

Formerly, an international organization that defined standards for telegraphic and telephone equipment. It has been incorporated into its parent organization, International Telecommunication Union (**ITU**). Telecommunication standards are now covered under Telecommunications Standards Sector (TSS). ITU-T replaces CCITT. For example, the Bell 212A standard for 1200 bps communication in North America was referred to as CCITT V.22. It is now referred to as ITU-T V.22.

Character

A representation, coded in **binary digits**, of a letter, number, or other symbol.

Characters Per Second

A data transfer rate generally estimated from the **bit rate** and the **character** length.

For example, at 2400 bps, 8-bit characters with **Start** and **Stop bits** (for a total of ten bits per character) will be transmitted at a rate of approximately 240 characters per second (cps). Some protocols, such as USR-HST and MNP, employ advanced techniques such as longer transmission **frames** and **data compression** to increase cps.

Class 1/EIA-578

An American standard used between facsimile application programs and facsimile modems for sending and receiving Class 1 faxes.

Class 2.0/EIA-592

An American standard used between facsimile application programs and facsimile modems for sending and receiving Class 2.0 faxes.

Cyclic Redundancy Checking (CRC)

An error-detection technique consisting of a cyclic algorithm performed on each block or **frame** of data by both sending and receiving modems. The sending modem inserts the results of its computation in each data block in the form of a CRC code. The receiving modem compares its results with the received CRC code and responds with either a positive or negative acknowledgment. In the ARQ protocol implemented in U.S. Robotics high speed modems, the receiving modem accepts no more data until a defective block is received correctly.

Data Communications

A type of communications in which computers and terminals are able to exchange data over an electronic medium.

Data Compression

When the transmitting modem detects redundant units of data, it recodes them into shorter units of fewer bits. The receiving modem then decompresses the redundant data units before passing them to the receiving computer.

Data Compression Table

A table of values assigned for each character during a call under data compression. Default values in the table are continually altered and built during each call: the longer the table, the more efficient throughput gained.

If a destructive Break is sent during a call (see the &Y command), causing the modems to reset the compression tables, you can expect diminished throughput.

Data Mode

The mode in which the fax modem is capable of sending and receiving data files. A standard modem without fax capabilities is always in Data mode.

DCE

Data Communication (or Circuit-Terminating) Equipment. In this manual, the term applies to dial-up modems that establish and control the data link via the telephone network.

Dedicated Line

A user-installed telephone line used to connect a specified number of computers or terminals within a limited area, for example, one building. The line is a cable rather than a public-access telephone line. The communications channel may also be referred to as nonswitched because calls do not go through telephone company switching equipment.

Default

Any setting assumed, at startup or reset, by the computer's software and attached devices, and operational until changed by the user.

Digital Loopback

A test that checks the modem's RS-232 interface and the cable that connects the terminal or computer and the modem. The modem receives data (in the form of **digital signals**) from the computer or terminal, and immediately returns the data to the screen for verification.

Digital Signals

Discrete, uniform signals. In this manual, the term refers to the **binary digits** 0 and 1.

Duplex

Indicates a communications channel capable of carrying signals in both directions. See **Half Duplex**, **Full Duplex**.

EIA

Electronic Industries Association, which defines electronic standards in the U.S.

Equalization

A compensation circuit designed into modems to counteract certain distortions introduced by the telephone channel. Two types are used: fixed (compromise) equalizers and those that adapt to channel conditions. U.S. Robotics high speed modems use adaptive equalization.

Error Control

Various techniques which check the reliability of characters (**parity**) or blocks of data. V.42, MNP and HST error control protocols use error detection (**CRC**) and retransmission of errored frames (**ARQ**).

Facsimile

A method for transmitting the image on a printed page from one point to another. Commonly referred to as Fax.

Fax Mode

The mode in which the fax modem is capable of sending and receiving files in a facsimile format.

Flow Control

A mechanism that compensates for differences in the flow of data input to and output from a modem or other device.

Frame

A data communications term for a block of data with header and trailer information attached. The added information usually includes a frame number, block size data, error-check codes, and Start/End indicators.

Full Duplex

Signal flow in both directions at the same time. In microcomputer communications, may refer to the suppression of the online **Local Echo**.

Half Duplex

Signal flow in both directions, but only one way at a time. In microcomputer communications, may refer to activation of the online **Local Echo**, which causes the modem to send a copy of the transmitted data to the screen of the sending computer.

HDLC

High Level Data Link Control. A standard protocol developed by the International Standards Organization for software applications and communicating devices operating in synchronous environments. The protocol defines operations at the link level of communications, for example, the format of data **frames** exchanged between modems over a phone line. See **Bisync, Protocol, SDLC**.

HST

High Speed Technology, U.S. Robotics' proprietary signaling scheme, design and error control protocol for high-speed modems. HST incorporates trellis-coded modulation, for greater immunity from variable phone line conditions, and asymmetrical modulation for more efficient use of the phone channel at speeds of 4800 bps and above. HST also incorporates **MNP**-compatible error control procedures adapted to asymmetrical modulation.

Hz

Hertz, a frequency measurement unit used internationally to indicate one cycle per second.

ITU-T

International Telecommunication Union-Telecommunication sector. Formerly referred to as CCITT. An international organization that defines standards for telegraphic and telephone equipment. For example, the Bell 212A standard for 1200 bps communication in North America is observed internationally as ITU-T V.22. For 2400 bps communication, most U.S. manufacturers observe V.22 *bis*.

LAPM

Link Access Procedure for Modems, an error control **protocol** incorporated in ITU-T Recommendation V.42. Like the **MNP** and **HST** protocols, LAPM uses cyclic redundancy checking (**CRC**) and retransmission of corrupted data (**ARQ**) to ensure data reliability.

Local Echo

A modem feature that enables the modem to send copies of keyboard commands and transmitted data to the screen. When the modem is in Command mode (not online to another system) the local echo is invoked through the ATE1 command. The command causes the modem to display your typed commands. When the modem is online to another system, the local echo is invoked through the ATF0 command. This command causes the modem to display the data it transmits to the remote system.

MI/MIC

Mode Indicate/Mode Indicate Common, also called Forced or Manual Originate. Provided for installations where other equipment, rather than the modem, does the dialing. In such installations, the modem operates in Dumb mode (no Auto Dial capability), yet must go off hook in **Originate mode** to connect with answering modems. See MI/MIC Closure in Appendix F.

MNP

Microcom Networking Protocol, an asynchronous error control protocol developed by Microcom, Inc. and now in the public domain. The protocol ensures error-free transmission through error detection (**CRC**) and retransmission of errored frames. U.S. Robotics modems use MNP Levels 1–4 and Level 5 data compression. MNP Levels 1–4 have been incorporated into ITU-T Recommendation V.42. Compare **HST**.

Modem

A device that transmits/receives computer data through a communications channel such as radio or telephone lines. The Courier is a telephone channel modem that modulates, or transforms, **digital signals** from a computer into the **analog** form that can be carried successfully on a phone line. It also demodulates signals received from the phone line back to digital signals before passing them to the receiving computer.

Nonvolatile Memory (NVRAM)

User-programmable random access memory whose data is retained when modem power is turned off. Used in Courier modems to store a user-defined default configuration loaded into random access memory (**RAM**) at power on.

OFF/ON Hook

Modem operations which are the equivalent of manually lifting a phone receiver (taking it off hook) and replacing it (going on hook).

Online Fallback

A feature that allows high speed error-control modems to monitor line quality and fall back to the next lower speed if line quality degrades. The modems fall forward as line quality improves.

Originate Mode

A state in which the modem transmits at the predefined low frequency of the communications channel and receives at the high frequency. The transmit/receive frequencies are the reverse of the called modem which is in **Answer mode**.

Parallel Transmission

The transfer of data characters using parallel electrical paths for each bit of the character, for example, 8 paths for 8-bit characters. Data is stored in computers in parallel form, but may be converted to serial form for certain operations. See **Serial Transmission**.

Parity

An error-detection method that checks the validity of a transmitted character. Character checking has been surpassed by more reliable and efficient forms of block-checking, including **Xmodem**-type protocols and the **ARQ** protocol implemented in Courier modems.

The same type of parity must be used by two communicating computers, or both may omit parity. When parity is used, a parity bit is added to each transmitted character. The bit's value is 0 or 1, to make the total number of 1's in the character even or odd, depending on which type of parity is used.

Protocol

A system of rules and procedures governing communications between two or more devices. Protocols vary, but communicating devices must follow the same protocol in order to exchange data. The format of the data, readiness to receive or send, error detection and error correction are some of the operations that may be defined in protocols.

RAM

Random Access Memory. Memory that is available for use when the modem is turned on, but that clears of all information when the power is turned off. The modem's RAM holds the current operational settings, a flow control **buffer**, and a command buffer.

Remote Access

A feature that allows a remotely-located user to view the Courier's configuration screens and change the Courier's configuration. Password protection is available.

Remote Digital Loopback

A test that checks the phone link and a remote modem's transmitter and receiver. Data entered from the keyboard is transmitted from the initiating modem, received by the remote modem's receiver, looped through its transmitter, and returned to the local screen for verification.

Remote Echo

A copy of the data received by the remote system, returned to the sending system and displayed on the screen. Remote echoing is a function of the remote system.

ROM

Read Only Memory. Permanent memory, not user-programmable. The Courier's factory settings are stored in ROM and can be read (loaded) into RAM as an operational configuration if DIP switch S10 is ON at power on.

Serial Transmission

The transfer of data characters one bit at a time, sequentially, using a single electrical path. See **Parallel Transmission**.

Start/Stop Bits

The signaling bits attached to a character before the character is transmitted during **Asynchronous Transmission**.

SDLC

Synchronous Data Link Control. A protocol developed by IBM for software applications and communicating devices operating in IBM's Systems Network Architecture (SNA). The protocol defines operations at the link level of communications, for example, the format of data **frames** exchanged between modems over a phone line. See **Bisync, Protocol, HDLC**.

Synchronous Transmission

A form of transmission in which blocks of data are sent at strictly timed intervals. Because the timing is uniform, no **Start** or **Stop bits** are required. Compare **Asynchronous Transmission**.

Some mainframes only support synchronous communications unless their owners have installed a synchronous adapter and appropriate software.

Terminal

A device whose keyboard and display are used for sending and receiving data over a communications link. Differs from a microcomputer in that it has no internal processing capabilities. Used to enter data into or retrieve processed data from a system or network.

Terminal Mode

An operational mode required for microcomputers to transmit data. In Terminal mode the computer acts as if it were a standard terminal such as a teletypewriter, rather than a data processor. Keyboard entries go directly to the modem, whether the entry is a modem command or data to be transmitted over the phone lines. Received data is output directly to the screen. The more popular communications software products control Terminal mode as well as enable more complex operations, including file transmission and saving received files.

Throughput

The amount of actual user data transmitted per second without the overhead of protocol information such as Start and Stop bits or frame headers and trailers. Compare **characters per second**.

Transmission Rate

Same as **Bit Rate**.

V.21—Fax

A **ITU-T** standard for facsimile operations at 300 bps. U.S. Robotics or compatible fax devices then transmit or receive at higher speeds.

V.21—Modem

A **ITU-T** standard for modem communications at 300 bps. Modems made in the U.S. or Canada follow the Bell 103 standard. However, the modem can be set to answer V.21 calls from overseas.

V.22

A **ITU-T** standard for modem communications at 1200 bps, compatible with the Bell 212A standard observed in the U.S. and Canada.

V.22 bis

A **ITU-T** standard for modem communications at 2400 bps. The standard includes an automatic link negotiation fallback to 1200 bps and compatibility with Bell 212A/V.22 modems.

V.23

A **ITU-T** standard for modem communications at 1200 bps with a 75 bps back channel. Used in the U.K.

V.25

A **ITU-T** standard for modem communications that specifies an answer tone different from the Bell answer tone used in the U.S. and Canada. All U.S. Robotics modems can be set with the B0 command so that they use the V.25 2100 Hz tone when answering overseas calls.

V.25 bis

A **ITU-T** standard for synchronous communications between the mainframe or host and the modem using the HDLC or character-oriented protocol. Modulation depends on the serial port rate and setting of the transmitting clock source, &X.

V.27 ter

A **ITU-T** standard for facsimile operations that specifies modulation at 4800 bps, with fallback to 2400 bps.

V.17

A **ITU-T** standard for facsimile operations that specifies modulation at 14.4K bps, with fallback to 12K bps.

V.29

A **ITU-T** standard for facsimile operations that specifies modulation at 9600 bps, with fallback to 7200 bps.

V.32

A **ITU-T** standard for modem communications at 9600 bps and 4800 bps. V.32 modems fall back to 4800 bps when line quality is impaired, and fall forward again to 9600 bps when line quality improves.

V.32 bis

A **ITU-T** standard that extends the V.32 connection range: 4800, 7200, 9600, 12K and 14.4K bps. V.32 *bis* modems fall back to the next lower speed when line quality is impaired, and fall back further as necessary. They fall forward to the next higher speed when line quality improves.

V.42

A **ITU-T** standard for modem communications that defines a two-stage process of detection and negotiation for LAPM error control. V.42 also supports the MNP error control protocol, levels 1–4.

V.42 bis

An extension of **ITU-T** V.42 that defines a specific data compression scheme for use with V.42 and MNP error control.

Word Length

The number of bits in a data character without parity, start or stop bits.

Xmodem

The first of a family of error control software **protocols** used to transfer files between modems. These protocols are in the public domain and are available from many bulletin board services.

XON/XOFF

Standard **ASCII** control characters used to tell an intelligent device to stop/resume transmitting data. In most systems typing <Ctrl>-S sends the XOFF character. Some devices, including the Courier, understand <Ctrl>-Q as XON; others interpret the pressing of any key after <Ctrl>-S as XON.

APPENDIX I. TECHNICAL SPECIFICATIONS

U.S. ROBOTICS HIGH SPEED TECHNOLOGY (HST)

16.8K, 14.4K, 12K, 9600, 7200 bps, synchronous/asynchronous, asymmetrical, 450 bps back channel with automatic handshake adjustment to 300 bps, Trellis Coded Modulation (TCM), Quadrature Amplitude Modulation (QAM)

4800 bps, synchronous/asynchronous, asymmetrical, 450 bps back channel with automatic handshake adjustment to 300 bps, Quadrature Amplitude Modulation (QAM)

U.S. ROBOTICS V.32 TERBO

21.6K, 19.2K, 16.8K, 14.4K. 12K, 9600, 7200 bps asynchronous, 19.2K, 16.8K, 14.4K. 12K, 9600, 7200 bps synchronous, Trellis Coded Modulation (TCM)

4800 bps, synchronous/asynchronous, Quadrature Amplitude Modulation (QAM)

ADDITIONAL COMPATIBILITY FEATURES

ITU-T V.32 *bis*, 14400, 9600 bps, synchronous, asynchronous, Trellis Coded Modulation (TCM); 4800 bps, synchronous, asynchronous, Quadrature Amplitude Modulation (QAM)

ITU-T V.32, 9600 bps, synchronous, asynchronous, Trellis Coded Modulation (TCM); 4800 bps, synchronous, asynchronous, Quadrature Amplitude Modulation (QAM)

ITU-T V.25 2100 Hz tone

ITU-T V.23, 1200 bps, asymmetrical (1200/75 bps), Frequency Shift Keying (FSK)

ITU-T V.22 *bis*, 2400 bps, synchronous/asynchronous, Quadrature Amplitude Modulation (QAM)

ITU-T V.22, 1200 bps, synchronous/asynchronous, Differential Phase Shift Keying (DPSK)

Bell 212A, 1200 bps, synchronous/asynchronous, Differential Phase Shift Keying (DPSK)

Bell 103, 300 bps, asynchronous, Frequency Shift Keying (FSK)

ITU-T V.21, 300 bps, asynchronous, Frequency Shift Keying (FSK)

U.S. Robotics HST error control protocol, asymmetrical mode, at 16.8K, 14.4K, 12K, 9600, 7200, 4800 bps, 450/300 bps back channel

ITU-T V.42 error control protocol at 14.4K, 12K, 9600, 7200, 4800 bps (V.32 *bis* mode) and at 2400/1200 bps

ITU-T V.42 *bis* data compression (all modes and speeds of 1200 bps and higher)

Microcom Networking Protocol (MNP) error control protocol, Levels 2-4 at 14.4K, 12K, 9600, 7200, 4800 bps (V.32 *bis* mode) and at 2400/1200 bps

Microcom Networking Protocol (MNP) Level 5 data compression (all modes and speeds of 1200 bps and higher)

DB-25 RS-232 terminal/modem interface

Superset of industry standard AT command set, S-registers, DIP switches

Optional MI/MIC closure

Optional pulsed DSR

ITU-T V.32 BIS

14.4K. 12K, 9600, 7200 bps, synchronous/asynchronous, Trellis Coded Modulation (TCM)

4800 bps, synchronous/asynchronous, Quadrature Amplitude Modulation (QAM)

ADDITIONAL COMPATIBILITY FEATURES

ITU-T V.32, 9600 bps, synchronous, asynchronous, Trellis Coded Modulation (TCM); 4800 bps, synchronous, asynchronous, Quadrature Amplitude Modulation (QAM)

ITU-T V.25 2100 Hz tone

ITU-T V.23, 1200 bps, asymmetrical (1200/75 bps), Frequency Shift Keying (FSK)

ITU-T V.22 *bis*, 2400 bps, synchronous/asynchronous, Quadrature Amplitude Modulation (QAM)

ITU-T V.22, 1200 bps, synchronous/asynchronous, Differential Phase Shift Keying (DPSK)

Bell 212A, 1200 bps, synchronous/asynchronous, Differential Phase Shift Keying (DPSK)

Bell 103, 300 bps, asynchronous, Frequency Shift Keying (FSK)

ITU-T V.21, 300 bps, asynchronous, Frequency Shift Keying (FSK)

U.S. Robotics HST error control protocol, asymmetrical mode, at 16.8K, 14.4K, 12K, 9600, 7200, 4800 bps, 450/300 bps back channel

ITU-T V.42 error control protocol at 14.4K, 12K, 9600, 7200, 4800 bps (V.32 *bis* mode) and at 2400/1200 bps

ITU-T V.42 *bis* data compression (all modes and speeds of 1200 bps and higher)

Microcom Networking Protocol (MNP) error control protocol, Levels 2-4 at 14.4K, 12K, 9600, 7200, 4800 bps (V.32 *bis* mode) and at 2400/1200 bps

Microcom Networking Protocol (MNP) Level 5 data compression (all modes and speeds of 1200 bps and higher)

DB-25 RS-232 terminal/modem interface

Superset of industry standard AT command set, S-registers, DIP switches

Optional MI/MIC closure

Optional pulsed DSR

SERIAL PORT RATES

115.2K, 57.6K, 38.4K, 19.2K, 9600, 4800, 2400, 1200, 300 bps

LINK RATES

Data mode:	**V.32 *terbo*:** 21.6K, 19.2K, 16.8K bps **HST:** 16.8K bps **Both:** 14.4K, 12K, 9600, 7200, 4800, 2400, 1200, 300 bps
Fax mode:	14.4K, 12K, 9600, 7200, 4800, 2400, 300 bps

ADAPTIVE SPEED LEVELING

21.6K, 19.2K, 16.8K, 14.4K, 12K, 9600, 7200, 4800 bps

PHONE LINE INTERFACE

RJ11, RJ45S phone jacks

COMMUNICATIONS CHANNEL

Full/half duplex on 2-wire dial-up, dedicated, or leased phone lines; demand-driven high speed channel turnaround in HST mode; symmetrical speeds in V.32 *bis* mode

OPERATIONAL MODES

Synchronous/Asynchronous, Auto Dial/Answer, Manual Originate/Answer, Smart/Dumb mode, Auto Dial/Auto Answer, Auto Answer only, Forced Originate (MI/MIC)

Fax Modems: The above modes plus fax mode

FAX SERVICE CLASS 1 COMMANDS

+FCLASS=n (0,1)	Class identification and control
+FTS=n (0,255)	Stop transmission and pause, 10ms.
+FRS=n (0,255)	Wait for silence, 10 ms.
+FTM=n (3,24,48,72,73,74,96,121,122,145,146)	Transmit data with carrier
+FRM=n (3,24,48,72,73,74,96,121,122,145,146)	Receive data with carrier
+FTH=n (3,24,48,72,73,74,96,121,122,145,146)	Transmit HDLC data with carrier
+FRH=n (3,24,48,72,73,74,96,121,122,145,146)	Receive HDLC data with carrier

FAX SERVICE CLASS 2.0 COMMANDS

Class 2.0 fax commands are too numerous to be listed here. For information on Class 2.0 technical specifications, contact Global Engineering Documents, at 1-800-854-7179. The document that covers this information is:

ANSI/EIA/TIA-592-1993 (EIA-592)
Asynchronous Facsimile DCE Control Standard
May, 1993

Optional Class 2.0 FAX commands supported

U.S. Robotics implements the following optional Class 2.0 fax commands :

+FNS=0,1	Pass-through non-Standard negotiation byte string
+FCR=0,1	Capability to receive
+FAA=0,1	Adaptive Answer mode
+FCT=0-255 sec.	Phase C Timeout
+FHS=0-255	Hangup Status Code, read only
+FMS=0-3	Minimum Phase C Speed
+FBS?=500,100	Buffer size, read only

DIALING

Dialing Rotary (pulse 0-9), Tone (DTMF 0-9, #, *), a-z when in Quote (") Mode

DATA FORMAT

Binary, serial; defaults to 8-bit word length, no parity, and 1 stop bit

Word Length	Parity (1 Bit)	Stop Bits
7	Even, Odd Mark, Space	1
7	None	2
8	None	1

V.25 BIS SYNCHRONOUS COMMANDS AND RESULT CODES

Commands: Connect incoming call (CIC); Call request using number provided (CRN); Call Request with memory location (CRS); Disregard incoming call (DIC); Program number (PRN*n*); Request list of forbidden numbers (RFN); Request list of stored numbers (RLN).

Dial options: 0–9 & : > < = P T);

Result Codes: Call failure indication (CFI) with optional parameters: Abort call (CFAB); local modem busy (CFCB); Engaged tone (CFET); Forbidden call (CFFC); Number not stored (CFNS); Answer tone not detected (CFNT); Ring tone (CFRT); Connect (CNX); List of numbers (LS); List of forbidden numbers (LSF); List of stored numbers (LSN); Incoming call (INC); Invalid (INV) with optional parameters: Message syntax error (INVMS); Command Unknown (INVCU); Parameter syntax error (INVPS); Parameter value error (INVPV); Valid (VAL).

Commands and Result Codes not supported: Call request with identification number (CRI); Program identifier (PRI); Request list of identification numbers (RLI); List of delayed call numbers (RLD).

FRONT PANEL STATUS LIGHTS

HS	High Speed (above 2400 bps)
AA	Auto Answer/Answer
CD	Carrier Detect
OH	Off Hook
RD	Received Data
SD	Send Data
TR	Terminal Ready (DTR)
MR	Modem Ready/Test mode
RS	Request to Send
CS	Clear to Send
SYN	Synchronous mode
ARQ/	Error control connection established
FAX	Modem in Fax mode

FLOW CONTROL BUFFERS

Transmit Buffer

Error control: 3.25k bytes

Non-Error control: 1.5k bytes, 128-byte option

Receive Buffer: 2K bytes

COMMAND BUFFER

40 characters, exclusive of AT prefix, Carriage Return and spaces

TEST OPTIONS

Analog loopback with test pattern
Remote digital loopback
Digital loopback
Test pattern
Dial test

CALL PROGRESS CODES

FAX
DATA
NO DIAL TONE
BUSY
NO ANSWER
RINGING
VOICE

FAILED CALL TIMEOUT

60-sec. default, programmable 2-255 sec.

ANSWER TONE TIMEOUT

60 sec.

ANSWER TONE DETECTOR

2200-2300 Hz

LOSS OF CARRIER (DISCONNECT TIMER)

0.7-sec. default, programmable 0.2-25.5 sec.

EQUALIZATION

Adaptive

TRANSMITTER CARRIER FREQUENCIES

USR-V.32 *terbo*
Originate Mode: 1800 Hz
Answer Mode: 1800 Hz
USR-HST, 450 bps back channel
Originate Mode: 375 Hz
Answer Mode: 1800 Hz

USR-HST, 300 bps back channel
Originate Mode: 350 Hz
Answer Mode: 1800 Hz

V.32 *bis*
Originate Mode: 1800 Hz
Answer Mode: 1800 Hz

V.23
Originate Mode:
Mark: 390 Hz
Space: 450 Hz
Answer Mode:
Mark: 1300 Hz
Space: 2100 Hz

V.22 *bis*, V.22, Bell 212A
Originate Mode: 1200 Hz
Answer Mode: 2400 Hz

Bell 103
Originate Mode:
Mark: 1270 Hz
Space: 1070 Hz
Answer Mode:
Mark: 2225 Hz
Space: 2025 Hz

V.21
Originate Mode:
Mark: 980 Hz
Space: 1180 Hz
Answer Mode:
Mark: 1650 Hz
Space: 1850 Hz

RECEIVER CARRIER FREQUENCIES

USR-V.32 *terbo*
Originate Mode: 1800 Hz
Answer Mode: 1800 Hz

USR-HST, 450 bps back channel
Originate Mode: 1800 Hz
Answer Mode: 375 Hz

USR-HST, 300 bps back channel
Originate Mode: 1800 Hz
Answer Mode: 350 Hz

V.32 *bis*
Originate Mode: 1800 Hz
Answer Mode: 1800 Hz

V.23
Originate Mode:
Mark: 1300 Hz
Space: 2100 Hz
Answer Mode:
Mark: 390 Hz
Space: 450 Hz

V.22 *bis*, V.22, Bell 212A
Originate Mode: 2400 Hz
Answer Mode: 1200 Hz

Bell 103
Originate Mode:
Mark: 2225 Hz
Space: 2025 Hz
Answer Mode:
Mark: 1270 Hz
Space: 1070 Hz

V.21
Originate Mode:
Mark: 1650 Hz
Space: 1850 Hz
Answer Mode:
Mark: 980 Hz
Space: 1180 Hz

RECEIVE SENSITIVITY

- 44 dBm ± 2 dBm

TRANSMIT LEVEL

- 9 dBm maximum

TRANSMITTER FREQUENCY TOLERANCE

.01%

CERTIFICATION

FCC Part 68 and Part 15, Class B Domestic; DOC (Canada), UL listed

POWER CONSUMPTION

5 watts

SIZE

6.25 x 10.25 x 1.5 inches

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Commands

Bold-faced page numbers indicate the primary information source for an entry.

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Printing 9 8 7

U.S. Robotics
The Intelligent Choice in Data Communicati

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The Intelligent Choice in Data Communications

COURIER™
HIGH SPEED MODEMS

QUICK-REFERENCE CARD

COURIER HST Dual Standard FAX™ with ASL™

COURIER V.32 *terbo* FAX™ with ASL™

BASIC COMMAND SET

Command	Function/Options
&	See Extended Command Set.
%	See Extended Command Set.
A	Force Answer mode when modem hasn't received an incoming call.
A/	Re-execute last command once.
A>	Repeat last command continuously.
Any key	Terminate current connection attempt; exit Repeat mode.
AT	Attention: *must* precede all other commands, except A/, A> and + + +.
B*n*	Handshake options. B0 V.32/V.32 *bis* mode; ITU-T answer sequence B1 HST mode; Bell answer tone
D*n*	Dial the number that follows and go into Originate Mode. Use any of the following options: P Pulse dial—Default T Tone dial , (Comma) Pause for 2 seconds ; Return to command state after dialing " Dial the letters that follow ! Flash switch-hook to transfer call W Wait for second dial tone (if X3 or higher is set) @ Wait for an answer (if X3 or higher is set) R Reverse frequencies
DL	Dial the last-dialed number.
DS*n*	Dial number stored in NVRAM at position *n*.
E*n*	Command mode local echo. Not applicable once a connection has been made. See DIP switch 4. E0 Echo OFF E1 Echo ON
F*n*	Local echo ON/OFF once a connection has been made. F0 Echo ON (Half Duplex) F1 Echo OFF (Full Duplex)—Default
H*n*	On/off hook control. H0 Hang up (go on hook)—Default H1 Go off hook
I*n*	Inquiry. I0 Return product code I1 Return memory (ROM) checksum I2 Run memory (RAM) test I3 Return call duration/real time I4 Return current modem settings I5 Return NVRAM settings I6 Return link diagnostics I7 Return product configuration I10 Return Dial Security account status
K*n*	Modem clock operation. K0 At ATI3, ATI6, display current or last call duration. Default K1 At ATI3, ATI6, display real time; set clock with ATI3 = HH:MM:SSK1
M*n*	Monitor (speaker) control. M0 Speaker always OFF M1 Speaker ON until carrier is established—Default

BASIC COMMAND SET

Command	Function/Options
	M2 Speaker always ON M3 Speaker ON after last digit dialed, OFF at carrier detect
O*n*	Return online after command execution. O0 Return online, normal O1 Return online, retrain
P	Pulse dial.
Q*n*	Result codes display. Q0 Result codes displayed Q1 Result codes suppressed (Quiet mode) Q2 Quiet in Answer mode only
S*r*=*n*	Set Register commands: *r* is any S-register; *n* must be a decimal number between 0 and 255.
S*r*.*b*=*n*	Set bit *b* of Register *r* to *n* (0/OFF or 1/ON).
S*r*?	Query register *r*.
T	Tone dial.
V*n*	Verbal/Numeric result codes. See DIP switch 2. V0 Numeric Mode V1 Verbal Mode
X*n*	Result Code options 0–7. See table in Chapter 3 of manual. Default is X7.
Z	Software reset. See DIP switch 10.
+ + +	Escape code sequence, preceded and followed by at least one second of no data transmission. See DIP switch 9.
/	(Slash) Pause for 125 msec.
>	Repeat command continuously or up to 10 dial attempts. Cancel by pressing any key.
$	Help Basic command summary.
&$	Help Ampersand command summary.
%$	Help Percent command summary.
D$	Help Dial command summary.
S$	Help S-register summary.

EXTENDED COMMAND SET

Command	Function/Options
&A*n*	ARQ result codes. &A0 Suppress ARQ result codes &A1 Display ARQ result codes &A2 Display HST and V.32 result codes &A3 Display protocol result codes-Default
&B*n*	Data Rate, terminal-to-modem (DTE/DCE). &B0 DTE rate follows connection rate &B1 Fixed DTE rate-Default &B2 Fixed DTE rate in ARQ mode; variable DTE rate in non-ARQ mode
&C*n*	Carrier Detect (CD) operations. See DIP switch 6. &C0 CD override &C1 Normal CD operations
&D*n*	Data Terminal Ready (DTR) operations. See DIP switch 1. &D0 DTR override

EXTENDED COMMAND SET

Command	Function/Options
	&D1 Online command mode with DTR toggle
	&D2 Normal DTR operations
&F*n*	Load factory settings into random access memory (RAM).
&G*n*	Guard tone.
	&G0 No guard tone, U.S., Canada—Default
	&G1 Guard tone, some European countries
	&G2 Guard tone, U.K.; requires B0
&H*n*	Transmit Data flow control.
	&H0 Flow control disabled
	&H1 Hardware (CTS) flow control-Default
	&H2 Software (XON/XOFF) flow control
	&H3 Hardware and software control
&I*n*	Received Data software flow control.
	&I0 Flow control disabled—Default
	&I1 XON/XOFF to local modem and remote computer
	&I2 XON/XOFF to local modem only; ARQ mode only
	&I3 ARQ Host mode, Hewlett Packard protocol
	&I4 ARQ Terminal mode, Hewlett Packard protocol
	&I5 ARQ mode—same as &I2; non-ARQ mode—look for incoming XON/XOFF
&K*n*	Data compression.
	&K0 Disabled
	&K1 Auto enable/disable—Default
	&K2 Enabled
	&K3 V.42 *bis* only
&L*n*	Normal/Leased line operation.
	&L0 Normal phone line—Default
	&L1 Leased line
	&L2 Enable HST cellular
&M*n*	Error Control /Synchronous Options.
	&M0 Normal mode, no error control
	&M1 Async. command/sync. data
	&M2 Reserved
	&M3 Reserved
	&M4 Normal/ARQ mode—Normal if ARQ connection cannot be made—Default
	&M5 ARQ mode—hang up if ARQ connection cannot be made
	&M6 Character-oriented sync.
	&M7 HDLC sync.
&N*n*	Data Rate, data link (DCE/DCE).
	&N0 Normal link operations—Default
	&N1 300 bps &N6 9600 bps
	&N2 1200 bps &N7 12K bps
	&N3 2400 bps &N8 14.4K bps
	&N4 4800 bps &N9 16.8K bps
	&N5 7200 bps &N10 21.6K bps
&P*n*	Pulse dial make/break ratio.
	&P0 North America—Default
	&P1 British Commonwealth
&R*n*	Received Data hardware (RTS) flow control.
	&R0 Delay before CTS after RTS; see S26
	&R1 Ignore RTS
	&R2 Pass received data on RTS high; used only if terminal equipment supports RTS-Default

EXTENDED COMMAND SET

Command	Function/Options
&S*n*	Data Set Ready (DSR) override.
	&S0 DSR override (always ON—Default)
	%N*n* Sync. clock speed. See manual.
	&S1 Modem controls DSR
	&S2 Pulsed DSR; CTS follows CD
	&S3 Pulsed DSR
	&S4 Modem sends DTE DSR signal following CD
&T*n*	Modem Testing.
	&T0 End testing, see Register S18
	&T1 Analog Loopback
	&T2 Reserved
	&T3 Digital Loopback
	&T4 Grant Remote Digital Loopback
	&T5 Deny Remote Digital Loopback
	&T6 Initiate Remote Digital Loopback
	&T7 Remote Digital Loopback with self test
	&T8 Analog Loopback with self test
&W	Write current settings to NVRAM.
&X*n*	Synchronous timing source. See manual.
&Y*n*	Break handling. Destructive Breaks clear the buffer; expedited Breaks are sent immediately to the remote system.
	&Y0 Destructive, but don't send Break
	&Y1 Destructive, expedited—Default
	&Y2 Nondestructive, expedited
	&Y3 Nondestructive, unexpedited
&Z*n*=*L*	Store last-dialed phone number in NVRAM at position *n*.
&Z*n*=*s*	Write phone number (*s*) to NVRAM at position *n* (0–9). 36 characters maximum.
&Z*n*?	Display phone number stored in NVRAM at position *n* (*n*=0–9).
&ZC=*s*	Write command string (*s*) to NVRAM.
&ZC?	Display stored command string.
%B*n*	Remotely set local serial port rate.
	%B0 110 bps %B5 4800 bps
	%B1 300 bps %B6 9600 bps
	%B2 600 bps %B7 19.2K bps
	%B3 1200 bps %B8 38.4K bps
	%B4 2400 bps %B9 57.6K bps
	%B10 115.2K bps
%C*n*	Remotely set local configuration.
	%C0 Defer configuration until call is ended—Default
	%C1 Restore original configuration
	%C2 Execute configuration immediately
%F*n*	Remotely set local data format.
	%F0 No parity, 8 data bits
	%F1 Mark parity, 7 data bits
	%F2 Odd parity, 7 data bits
	%F3 Even parity, 7 data bits
%N*n*	Sync. clock speed. See manual.
%P*n*=*s*	Set the following password string (*s*) at position *n* (*n*= 0 or 1).
%P*n*?	Display the password stored at position *n* (*n*= 0 or 1).
%T	Enable tone recognition.

DIP SWITCHES: UP = OFF DOWN = ON

Switch	Factory Setting	Function	
1	UP	Data Terminal Ready Operations	
		UP	DTR normal: required for modem to accept commands, dropping DTR terminates a call
		DOWN	DTR always ON (Override)
2	UP	Verbal/Numeric Result Codes	
		UP	Verbal (word) messages
		DOWN	Numeric result codes
3	DOWN	Result Code Display	
		UP	Quiet mode, no display
		DOWN	Result codes displayed
4	UP	Command Mode Local Echo	
		UP	Modem echoes (displays) commands
		DOWN	Modem does not echo
5	DOWN	Auto Answer	
		UP	Modem answers on first ring
		DOWN	Auto Answer Suppressed
6	UP	Carrier Detect Operations	
		UP	CD indicates the modem is online and a carrier signal is present
		DOWN	Carrier Detect signal always ON (Override)
7	UP	Auxiliary Switch, DIP Switch 3 DOWN	
		UP	Result codes displayed in both Originate and Answer modes
		DOWN	Result codes suppressed in Answer mode
8	DOWN	AT Command Set Recognition	
		UP	AT command set recognition disabled
		DOWN	Normal operations
9	UP	Escape Code (+ + +) Response	
		UP	Modem disconnects, returns to Command Mode, returns NO CARRIER result
		DOWN	Modem keeps line open, returns to Command Mode, returns OK result
10	UP	Power-on Software Defaults	
		UP	Load from NVRAM
		DOWN	Load factory settings
Quad Switch	UP	Send/Receive pin assignments, Computer/modem interface	
		UP	Normal
		DOWN	Reversed

Register	Function	Default
S0	Set number of rings before automatic answering when DIP switch 5 is UP. Default = 1. S0 = 0 suppresses Auto Answer, equivalent to DIP switch 5 DOWN.	See DIP Switch 5
S1	Counts and stores number of rings from an incoming call.	0
S2	Define escape code character. Default = +.	43
S3	Define ASCII Carriage Return.	13
S4	Define ASCII Line Feed.	10
S5	Define ASCII Backspace.	8
S6	Set number of seconds modem waits before dialing.	2
S7	Set number of seconds modem waits for a carrier.	60
S8	Set duration, in seconds, for pause (,) option in Dial command and pause between command re-executions for Repeat (>) command.	2
S9	Set duration, in tenths of a second, of remote carrier signal before recognition.	6
S10	Set duration, in tenths of a second, modem waits after loss of carrier before hanging up.	7
S11	Set duration and spacing, in milliseconds, of dialed tones.	70
S12	Define guard time, in 50ths of a second, for escape code sequence.	50
S13	Bit-mapped register: 1 Reset when DTR drops 2 Auto Answer in Originate Mode 4 Disable result code pause 8 DS0 on DTR low-to-high 16 DS0 on power up. ATZ 32 Disable HST modulation 64 Disable MNP Level 3 128 Watchdog hardware reset	0
S15	Bit-mapped register: 1 Disable high-frequency equalization 2 Disable online fallback 4 Force 300-bps back channel 8 Set non-ARQ Transmit buffer to 128 bytes 16 Disable MNP Level 4 32 Set Del as Backspace key 64 Unusual MNP incompatibility 128 Custom applications only	0
S16	Bit-mapped register: 1 Analog Loopback 2 Dial Test 4 Test Pattern 8 Initiate Remote Digital Loopback 16 through 128, Reserved	0
S18	&T*n* Test timer, disabled when S18 is set to 0 seconds.	0
S19	Set Inactivity Timer, minutes. Disabled when set to 0.	0

S-REGISTERS

Register	Function	Default
S21	Length of Break, DCE to DTE, in 10-millisecond units.	10
S22	Define ASCII XON.	17
S23	Define ASCII XOFF.	19
S24	Sets duration, in 20-millisecond units, of pulsed DSR when modem is set to &S2 or &S3.	150
S26	Sets duration, in 10-millisecond units, of delay between RTS and CTS, synchronous mode.	1
S27	Bit-mapped register: 1 Enable V.21 modulation, 300 bps 2 Enable unencoded V.32 modulation 4 Disable V.32 modulation 8 Disable 2100 Hz answer tone 16 Disable MNP handshake 32 Disable V.42 Detect phase 64 Reserved 128 Unusual software incompatibility	0
S28	Sets duration, in tenths of a second, of V.32 handshake delay.	8
S29	Sets duration, in tenths of a second, of V.21 handshake delay.	20
S32	Voice/Data switch options: 0 Disabled 1 Go off hook in Originate mode 2 Go off hook in Answer mode 3 Redial last-dialed number 4 Dial number stored at position 0 5 Auto Answer toggle on/off 6 Reset modem 7 Initiate Remote Digital Loopback 8 Busy out phone line toggle 9 Execute stored command string	9
S34	Bit-mapped register: 1 Disable V.32 *bis* 2 Disable Enhanced V.32 mode 4 Disable Quick V.32 Retrain 8 Enable V.23 modulation 16 Change MR LED to DSR 32 Enable MI/MIC 64 Reserved 128 Reserved	0
S38	Sets duration, in seconds, before disconnect when DTR drops during an ARQ call.	0
S41	Sets number of allowable login attempts for remote access.	0
S42	Define ASCII remote access escape character.	126
S43	Define guard time, in 50ths of a second, for remote access sequence.	100
S44	Set duration, in seconds, delay between when modem senses loss of carrier and attempt top re-establish a leased-line connection.	15
S51	Bit-mapped register: see manual.	0
S53	Bit-mapped register: 1 Dial Security enabled 2 Prompting enabled 4 Local-access password protection enabled	0